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NORTH AMERICA AND EUROPE: A GEOGRAPHICAL COMPARISON.[1]

NOTHING could surpass my curiosity when I landed for the first time in North America, a new world, separated from the old one by a great ocean. As a geologist, I knew that similar rocks formed the land and that similar surface features would occur, but as a geographer, I knew too that the vegetation of North America differs from that of Europe and that there are only a few species common to both sides of the water. What will be the impression of the landscape—will it be European or a different type? But when I put my foot on the land near Quebec I became aware that the general features of the landscape and the surroundings of man were nearly the same there as in Europe, and only a closer inspection convinced me that I was amid a new flora. Indeed, I had the feeling of being not in a latitude south of Vienna, whence I had just come, but rather of being in the same surroundings as at Stockholm—twelve degrees of latitude farther north.

There are, indeed, very strong similarities between North America and Europe. A superficial glance at our maps will reveal similar features. Europe is only a peninsula of Asia, and the peninsular character determines all features of this continent. North America may be compared with the whole of Eurasia, and its eastern part shows a similar peninsular articulation as

[1] Inaugural lecture by the Kaiser Wilhelm Professor, delivered at Columbia University on November 3, 1908.

Europe. That peninsular region stretches east of the Mississippi Valley, the region of the Great Lakes and Hudson Bay, and there are doubtless more pronounced geographical differences between this articulated part and the continental part of North America than between peninsular North America and peninsular Eurasia—that is, Europe.

Europe gets its characteristic features from some invasions of the sea. Northeast of Scandinavia a part of the Arctic Sea penetrates into the land and branches here as the White Sea. Farther south the very edge of the continent seems to be inundated, so that Great Britain and Ireland are isolated, and from the German Sea the Baltic Sea extends far into the interior of the continent. Still farther south is the Mediterranean Sea, which separates Europe from Africa. All these features seem to be repeated on the west side of the Atlantic. Here we see the Arctic water penetrating far to the south, forming Hudson Bay. Farther south the eastern corner of North America is inundated; Newfoundland is isolated, like Great Britain; and the Gulf of St. Lawrence extends far into the interior of the country, getting its waters from that remarkable group of lakes which in many respects resemble the Baltic Sea. This resemblance was far stronger at the end of the last geological epoch, when a vast body of fresh water existed instead of the Baltic Sea which poured through the river valley of the Sund between Denmark and Sweden into the basin of the German Sea. The resemblance of the Gulf of Mexico to the Mediterranean is such a striking one that Alexander von Humboldt called it a mediterranean sea; and, indeed, it divides America into two separate continents—North America and South America.

These similarities between Europe and peninsular North America are not merely superficial ones. In a very remarkable way, these two sides of the Atlantic repeat the same structural features; there is an astonishing symmetry, as Eduard Suess has shown so clearly. The northeast of Canada and Labrador on one side, and Scandinavia with Finland, the region of Feno-Scandia, on the other, are both composed of the oldest rocks we know of. These have a very complicated structure, being intruded with many eruptive rocks, and in a secondary way only, the surface features of the above regions are dependent on their structure. Both regions had already been leveled down before Cambrian times, and they sink gently down under a cover of horizontal Paleozoic strata. Both were called by Suess shields. The resemblance between these shields is the more conspicuous because both were covered during the last ice age by a glaciation which molded their surface in a similar way. In Sweden and Finland we find the same rounded glaciated surface, the same numerous lakes, as in Canada, both regions of the earth claiming to be the land of the many thousand lakes. At the border of both regions the horizontal Paleozoic strata begin with an escarpment which is pronouncedly developed south of Lake Erie and south of the Gulf of Finland, called here the "glint," and we shall keep this expression to designate similar escarpments. These strata continue far into the interior of Eurasia, and they do the same in North America.

In the same way that we compare the Canadian Shield with the Scandinavian Shield we can compare the region east of the Mississippi Valley with the interior of Russia—both parts of the world have never been compressed by mountain-folding since Paleozoic time. Only a few faults occur here, and the whole geological history consists in slight up-and-down warps which brought both regions several times under the surface of the transgressing ocean. Also, here the younger geological history

has augmented the similarity. Huge morainic accumulations south of the Great Lake region of North America form the watershed between the Mississippi and St. Lawrence Rivers, and similar morainic deposits form the watershed between the Baltic and the Black Seas. Thick loess deposits are found in front of these morainic deposits in the Mississippi basin as well as in the interior of Russia. The loess gives rich harvests to the corn regions of Iowa, Nebraska, Kansas, Missouri and Illinois, the counterparts of which are found in Wolhynia and the region of the Tshernosiom of the south central governments of Russia.

East of the Mississippi basin the old Paleozoic strata are folded and form the Appalachian belt, and similarly, west of the plains of Russia the Paleozoic strata of Europe are folded, forming a set of mountains which we can trace from the south of Russia to the west coast of Europe. In the central part of Germany these mountains constitute the belt of the German upland, and here it was that their geological history was first understood. The folding of the strata occurred near the end of the Paleozoic era and ceased before the end of the Permian epoch. Then they were base-leveled and covered totally or in part by Mesozoic deposits, after which mountains arose by faulting and warping, forming here and there true tilted blocks. The elevated parts lost their Mesozoic covering and the folded old strata again became visible.

This history is nearly the same as that of the Appalachian region. Here also the folding of the strata ended towards the close of the Paleozoic era and the folded mountains were leveled down. Then they became partly or totally covered with Mesozoic deposits, and the mountains of to-day were formed by upheaval. In North America, indeed, they form a more connected zone, while in Europe they are mostly groups of mountains, separated from each other by basins of Mesozoic or younger strata. During the epoch of folding, the Appalachian region and the zone of the Hercynian Mountains of Europe may have formed mountains of the height of the Alps of to-day. I called them, therefore, the Paleozoic Alps of middle Germany, but to-day these regions have only lower altitudes; they do not surpass, as the Appalachian region does, 2,000 meters. The striking features of these base-leveled Paleozoic mountains consist of the fact that on both sides of the Atlantic the belt of their ancient foot-hills contains coal measures. As the Allegheny region in North America, so the mountains of South Wales, the northern boundary of the Ardennes and of the neighboring Rhenish mountains contain the richest coal measures. And as we find west of the Allegheny region some coal measures, so we find some extensive coal layers north of the belt of the Hercynian Mountains in England and Scotland, in upper Siberia, in the east of Germany, and in some places in the interior of Russia. The industrial evolution of eastern United States, of England and Wales, or Belgium and the German empire, is based on the same fact, that a rich vegetation once covered the foot-hill region of the mountains up-turned towards the end of the Paleozoic era.

It is very interesting to see how the Appalachian region ends at Newfoundland, forming the projecting eastern corner of North America, and just opposite in south Ireland, in South Wales, in Cornwall and in Brittany the belt of the old Hercynian Mountains of Europe begins. One seems to be the continuation of the other, and such an excellent geologist as Marcel Bertrand maintained that we have here to deal with the two ends of one very extensive belt of mountains which extended through

the North Atlantic Ocean. But we must not forget that the missing link between both ends of these supposed mountain chains is longer than their known extent.

There are also similar structural features between the Mediterranean Sea and the Gulf of Mexico and its surroundings. Both seas consist of a set of very deep basins, separated by higher regions which reach more or less above the sea-level, and the Mesozoic strata in their vicinity are folded, but there is one very marked geographical difference between their surroundings. On the north side of the Mediterranean Sea extends a nearly uninterrupted belt of mountains which contains the highest elevation of Europe, while there is no high mountain range at all at the north of the Gulf of Mexico. The high elevations on the north side of the Mediterranean sharply divide western Europe into an Atlantic and a Mediterranean part, while all the natural regions of eastern North America continue uninterrupted to the Gulf. The high mountain belt on the north side of the Mediterranean Sea prevents the rivers from entering the Mediterranean; it pushes aside the Danube and only the east annex of the Mediterranean—the Black Sea—receives in the Danube, the Dneiper and the Don, important rivers which can be compared with the branches of the Mississippi River. But the river of Europe which as to size and ramifications bears most resemblance to the Mississippi—the Volga—empties its waters into the Caspian Lake. This, the largest lake on the earth, can be regarded, however, as an isolated basin of the Mediterranean. During the Ice Age its waters stood probably so high that they could overflow through the Manytsh Valley, north of the Caucasus, into the Black Sea so that the Volga got an outlet into the open sea. Therefore, during the Ice Age the arrangement of the eastern European rivers corresponded more nearly with that of the Mississippi and its branches, and this similarity would even exist if we assume that then the Black Sea itself was an inland sea, for such an inland sea could pour its waters through the Bosporus into the Mediterranean. The Bosporus, indeed, bears many features of a river valley, and it may have been at one time the outlet of all European rivers from the Danube to the Volga, of a body of water as large as that of the Mississippi. But while the large American river enters the sea through a large delta deposited by it, the European Mississippi passed through narrows just above its mouth, as the Hudson does; it had to force its way through the mountain belt north of the Mediterranean.

The absence of such a mountain belt in North America causes an important difference in the climate of the peninsular regions on both sides of the Atlantic. The climate of Europe is hardly at all affected by the Mediterranean, whereas the absence of a mountain belt north of the Gulf of Mexico allows the winds to sweep around the west end of that zone of high atmospheric pressure which extends across the Atlantic. Thus we have southwestern winds in North America; and as the southwestern winds of Europe bring the moisture and the warmth of the Gulf Stream drifts over large areas of Europe, so also the moisture and warmth of the Gulf of Mexico is brought into the southeastern part of North America. The effect of the cooling influences which the interior of a continent can exert by its high pressure and cold on the mean latitudes of its east coast, is counteracted to a large extent, and peninsular North America enjoys as well, but not as much, as the European peninsula of Eurasia, a peninsular climate.

But the peninsular climate of both sides of the Atlantic is not the same. It is most strongly developed in peninsular North

America in the south, but in Europe, in the north. The southwest winds blow in peninsular North America mostly during the summer; in Europe, however, during the winter, just at the time when cold northwest winds bring cold waves to the United States, and similar temperature is met with in very different latitudes of both sides of the Atlantic. Indeed, the climate on both sides of an ocean can not be the same; there must be differences between the east and west shores of the continents. Europe has the true climate of the west coast of a continent. The climate of this side of the Atlantic has its exact counterpart in North America in British Columbia, and the Mediterranean climate reoccurs in all of its characteristic features farther south in California. The high elevations of the mountains of British Columbia and of the Sierra Nevada, however, hinder the extension of these climatic conditions into the interior of the continent, while the open west of Europe allows the western winds to carry their moisture very far into the interior, and the long extent of the Mediterranean Sea is accompanied by a climate like that of California from the south of Spain over the south of Italy and Greece as far as Asia Minor. Thus one very large climatic province of very uniform character extends between the Atlantic Ocean and those semi-arid regions in which the higher civilization of the Orient in ancient times was born. And this climatic province possesses many features similar to those of semi-arid regions. This fact is of the greatest importance for the evolution of civilization in Europe.

We can trace back the European population very far. Man witnessed in Europe that set of climatic changes which characterize the great ice age, but while it is still open to discussion whether the present population of Europe had its origin in that very old one or whether it came from Asia, there can be no doubt that the European civilization has its root in the Orient. Here in Mesopotamia and in Egypt an early civilization arose under arid and semi-arid conditions, based on irrigation; this civilization was brought by early navigators over the whole basin of the Mediterranean and it found congenial conditions everywhere along the shores. In America such an evolution was impossible. Indeed, an original civilization has grown up here under semi-arid conditions, and it was based, too, on irrigation. This is not surprising. Irrigation is the easiest way to introduce agriculture. It is only necessary to distribute water and crops become possible. There is not necessary the very difficult work of clearing the forests. But a certain political organization is necessary which begins at the moment when the rules are established according to which the water is distributed.

The conditions under which the early civilization on the plateau of Mexico was developed are, indeed, in many respects similar to those of the Orient. That civilization, however, was not only far more feeble than that of the Orient, but it could not extend in the same way. The American Mediterranean is far larger than that between Europe and Africa, and early navigation did not find here the same landmarks which allowed the Phœnicians and Greeks to sail so far, but above all the shores of that sea were not as inviting to settlers as those of Greece, Italy, Spain or northern Africa. They are covered for a wide extent by dense, tropical, nearly impenetrable forests, and a belt of those virgin forests hindered the Mexicans from extending their civilization down to the Gulf of Mexico. At no time has this sea played a rôle similar to the Mediterranean; a Roman empire could never grow up east of the cradle of the American civilization

along the shores of the sea between North and South America.

The Roman empire was a true Mediterranean state, but it pushed forward its frontiers as well to the deserts of the Orient as to the woodlands in the north. Woodlands only rarely favor the evolution of a primitive civilization. Agriculture needs here more than irrigation; the forests must be cleared. This is a very hard work which goes on very slowly, and it must be followed by a continual struggle against the constantly new-growing forests. Here the family work has the greatest success and political organization only will very likely be formed. Indeed, the Romans regarded the wood-folk in the north as barbarians, though these had a civilization of their own which was of not inconsiderable height. They had already submitted extensive ground to agriculture; they already manufactured iron, and they were settled in villages and towns. But there can be no doubt that the Romans brought them more of the high civilization of the Orient than had reached them through the commerce of the Phœnicians and Greeks. By this, the Romans aided their neighbors in the north until finally the latter left their forests and conquered the south.

This political movement had as a starting-point central Europe. This is the center around which the other parts of Europe are arranged in such a way that they can be directly reached, and while most of these other parts are more or less separated from one another, lying isolated like Great Britain, or stretching into neighboring seas like Scandinavia, or Spain, or Italy, or the Balkan peninsula, they all are either connected with or are near to central Europe. Therefore, the relations between those members of Europe and the center were always active. Open to all sides, this center has suffered by its neighbors when its population was feeble and without force; or, on the other hand, when its inhabitants are strong, they influenced all Europe. More than once central Europe acted as the heart of the European body and drove fresh blood into the members.

When the forest-folk of central Europe had gained from the Romans knowledge of the favored regions of the Mediterranean basin rich in all kinds of fruit, they began to move towards the south; they laid in ruins the Roman empire and founded new kingdoms, but they could keep their nationality only where they appeared in great numbers. They were absorbed by the peoples of southern Europe, and the German ground extended only in the southwest, along the Rhine, and in England. England still bears the name of the German tribe—the Angles—who, together with the Saxons, conquered that extreme part of the old Roman empire, and in the whole of Europe we find witnesses of former German immigration. In the south of Spain, the name of Andalusia reminds us of the German tribe of the Vandalians who came from the Baltic Sea. In upper Italy, Lombardy conserves the name of those long-bearded Germans who settled there, and in the regions north of Milan you see more blond people with blue eyes than in many parts of the German empire. France received her name from the German Franks who extended their empire there.

The emigration of the German wood-folk seems not to have been caused by the pressure of other peoples. There seems to have been awakened a yearning among the German tribes to occupy better countries than their own. It seems to have been a similar longing to migrate and to settle new countries as that which prevailed in the eastern states of North America for more than one hundred years and which caused that enormous extent of the Anglo-Saxon race over the whole continent of North America. As in New England, the woodlands which were

left by their agricultural population were settled by new emigrants—the old Puritan ground being entered by Roman Catholic Irish and Italians and French Canadians and Russian Jews—so also in Germany the areas were resettled which had been left by their emigrating inhabitants, especially the eastern part. But the emigration had been more complete than in eastern New England, and the new settlers found a vacant country in which they could introduce their own language. A reaction, however, set in, and since the times of Charlemagne the Germans have been taking back their old land from a population whose descendants are to-day, in North America, classed as undesirable immigrants.

While this was beginning, the northern neighbors of the Germans, the Scandinavians, were seized with a similar longing to migrate that the Germans had experienced several hundred years ago, but while the Germans migrated on the land, the Scandinavians went on the sea. Scandinavian tribes crossed the Baltic Sea and crossed into the forests of northern Russia, where they founded the Russian empire, the name of which points back to the times when the Scandinavian conquerors used their slavish subjects as "rowsmen." Scandinavian pirates devastated the coast of northern Germany, of England, Scotland and France, where they settled, forming Normandy. They sailed into the Mediterranean Sea and at Constantinople met with countrymen going through Russia. Others went into the northern seas, discovering the Fäer Oer, Iceland and Greenland. They even came over to North America, but this discovery was accompanied by a large number of men prepared to settle, and it remained unknown to the greater part of Europe. Even Greenland was totally forgotten, and its few Scandinavian inhabitants expired when they came into contact with the Eskimo population. Thus the outburst of Scandinavian peoples, like the older outbursts of German peoples, resulted in but a slight expansion of Scandinavian ground. The Norman settlers along the Mediterranean and the shores of the Channel became intermixed with their neighbors, and when the Normans conquered England they brought with them French language and French customs.

In Germany, after the time of martial expansion of the people was over, more settled conditions ensued, and the vast forest-clad mountain regions which had heretofore been only visited by hunters were now cleared and a kind of interior colonization took place in the central part of the empire. The terminations "reute" and "schwende" of names of German villages indicate that the clearing of their forests was either by felling or burning the tree, and so famous became the Germans as clearers of woodland that they were called into the mountains of Bohemia, Silesia and Hungary, where peaceful colonization took place. German colonies, following the extension of German sea traffic, were founded along the shores of the Baltic Sea and even on the west coast of Norway, where the city of Bergen is a German colony; even centuries after, when the Russian empire had been extended from the Baltic to the Black Sea and to the Pacific, Germans were invited to settle in order to cultivate the country. These German colonies, which spread over all Russia, are found even in the steppe countries east of the Volga and of the Crimea.

Those waves of Asiatic steppe rough-riders which now and then spread out over the low ground of eastern Europe, were always broken when they reached German ground. Here the Hungarians were defeated. The Mongolian wave which had terminated the early Russian empire met with the same fate when it came to eastern Germany, as did the wave of Turks which

so easily rushed over Hungary. From the walls of Vienna imperial German armies drove back the Turks into those frontiers of Turkey, which lasted until the end of the nineteenth century, and German settlers founded a new culture in Hungary.

Thus the influence of early German conquest and later German peaceful colonization is felt nearly over the whole of Europe. The earlier conquest formed the nobility of France and Italy, where many noble families still conserve more or less corrupt German family names, and German names were long in use for noblemen in medieval times. German colonists developed the agricultural resources of the southeast and east of Europe and German merchants extended their commerce on the coast of the whole Atlantic Europe.

This kind of peaceful German extension is also favored by the central position of Germany in Europe, but it is very much based on the fact that Germany herself is not a country too much favored by nature, and it is her very poor soil which has educated her population to strong and intelligent labor. This population, however, increased to greater numbers than the ground could support, and this is the real cause of the expansion of German population by immigration, the influence of which has been so markedly felt by all Europe. It is the natural expansion of a strong, working forest-folk and one which resembles very much the expansion of the people on the east coast of North America over a whole continent.

The virgin forests of peninsular North America were far out of the reach of original American civilization, which could neither spread out over the shores of the American Mediterranean nor cross the arid regions and deserts north of Mexico. Their Indian inhabitants remained in the state of hunters and never cleared the woodland. The natural riches of that region were developed only when it was settled by Europeans, who had learned in Europe to overcome the resistance of forests to agriculture. And soon after its colonization, its population experienced that strong wish to expand which is so characteristic of early German migrations. The descendants of that population on the Atlantic slope of North America, who had cleared the virgin forests, crossed the Appalachian chain, cultivated the prairie grounds of the Mississippi basin, and adapted themselves to the arid climate of the west and the Italian climate of California. Thus the Atlantic side of North America plays in its colonization a rôle similar to that of Germany in the history of Europe.

The expansion of eastern North Americans, however, met with no strong resistance from the other inhabitants of North America. The Indians defended their ground in insufficient numbers and with insufficient arms, and they died out when they came into contact with higher civilization. In Europe, on the other hand, German emigrants spread amid peoples of larger numbers, and became, therefore, partly absorbed. The difference in expansion between the Atlantic North American and the German populations is neither caused by a greater strength of the North American expansion, nor by a lower education of German settlers; it is due to the fact that the North American expansion extended over a continent inhabited only by nomadic tribes of small numbers and of low civilization, while the German expansion extended over vast areas occupied by peoples with a culture and an organization of their own. This again is due to the fact that higher civilization spread out over all Europe, while the native civilization of North America remained restricted to the plateaus west of the Gulf of Mexico.

There is a remarkable resemblance between the expansion of German population

and that of America, and if we follow the latter to its sources we find that the early English settlers on the east coast are the descendants of German conquerors of England and their extension towards the west was followed and reinforced by a powerful wave of peaceful German immigrants, differing in language but similar in kind, and both waves formed one population in which the old German spirit of expansion is very active.

It is a curious chance that America received its name from a German geographer. Old Professor Waldseemueller made a mistake, indeed, when he named the new countries at Brazil after the Florentine Amerigo Vespucci. It would have been far more just to name the new world after Columbus, but though Waldseemueller recognized his mistake and withdrew the name, it remained in use. And curiously enough, that Amerigo Vespucci whose name gave origin to the name of America, had himself, though an Italian, still a German family name, Emmerich, Emery in English. Thus America is a continent with a German name, the meaning of which might, perhaps, be interpreted as "rich in corn";[2] if this is correct, Professor Waldseemueller chose an incorrect but appropriate name.

There are many connecting links between North America and Germany, but the strongest of these links is mutual friendship. True friendship needs no long words. I say to my friend, " Come, enter my house and feel at home"; and so I invite you to enter my home with me and to listen to my lectures on Germany.

ALBRECHT F. K. PENCK

REPORT OF THE COMMISSION ON AGRICULTURAL RESEARCH

THE Commission appointed by the Association of American Agricultural Colleges and Experiment Stations in 1906, to consider the organization and policy that should prevail in the expenditure of public funds for agricultural research, and kindred matters, has presented its report.

The members of the commission, David Starr Jordan, Stanford University, California, chairman; Whitman Howard Jordan, of Geneva, New York, secretary; Henry Prentiss Armsby, State College, Pennsylvania; Gifford Pinchot, Washington, D. C., and Carroll Davidson Wright, Clark College, Worcester, Massachusetts, agree in signing the report except that Mr. Pinchot makes some reservations. They summarize their recommendations as follows:

1. Every effort should be made to promote the training of competent investigators in agriculture both in the agricultural, and, so far as practicable, in the non-agricultural, colleges and universities, and their training should be as broad and severe as for any other field of research.

2. The progress of agricultural knowledge now demands that agricultural research agencies shall deal as largely as possible with fundamental problems, confining attention to such as can be adequately studied with the means available.

3. The work of research in agriculture should be differentiated as fully as practicable, both in the form of organization and in the relations of the individual investigator, from executive work, routine teaching, promotion and propaganda, and should be under the immediate direction of an executive trained in the methods of science who should not be hampered by other duties of an entirely unlike character.

4. The investigator should be free from all coercion whatever. In reaching his conclusions he should be equally free from the prescription of received opinion and the temptation to exploit his results for the purpose of obtaining future support. To this end, his work should be as far removed from immediate dependence upon legislation as is consistent with due responsibility to the public, and his relations to the public and to the organization of which he is a member should be such as to promote individual initiative and not interfere with freedom of conclusion or utterance on scientific questions.

5. There should be a clearer definition of the relative fields of work of the United States Department of Agriculture and the experiment stations. The dominance of the stations within their

[2] Amar, old German, a kind of wheat.

respective fields should be preserved and their growth fostered, as agencies for the investigation of local questions and of the more individual scientific problems. The federal agency, on the other hand, should cultivate the almost limitless field offered by questions having national or interstate relations and by those broad scientific problems requiring heavy expenditures, elaborate equipment, long continued study and the correlation of the results of many investigators, which efforts are usually beyond the means of an individual station. On many questions the harmonious cooperation of the two agencies is essential to the highest efficiency of effort.

6. Any research agency charged with a single main line of investigation should be so organized that it may employ within itself all necessary processes in any branch of science. The cooperation of any or all the departmnets of an experiment station on a single problem, when necessary, should be a fundamental requirement.

7. Research work, both national and state, should be provided for by separate, lump-sum appropriations, to be distributed according to the discretion of the responsible executive head of each agency.

8. Investigation into the business, economic, social and governmental conditions affecting agriculture should be undertaken and should be maintained on a permanent and effective basis.

9. An advisory board is suggested consisting of members appointed by the Secretary of Agriculture and by the Association of American Agricultural Colleges and Experiment Stations, respectively, which shall confer with the Secretary of Agriculture regarding the mutual interests of the department and the stations and shall consider the promotion of agricultural investigation in general.

THE RHODES SCHOLARSHIPS

The number of scholars in residence at Oxford under the Rhodes bequest during the academic year 1907–8 was 156. Sixty-six were from colonies of the empire, 11 from Germany and 79 from the United States of America. In addition to these, 11 men whose scholarship term had expired continued to reside in the university for a whole or part of the year; 1 as an official fellow, 2 as lecturers, 1 as a Senior Demy of Magdalen and 6 for further study in various subjects. At the end of the summer term 54 scholars completed their course at the university and took their examinations. At the beginning of the October term 1908 there was an entry of 78 new scholars, while 3 other scholars (colonial) who had temporary leave of absence returned to complete their course. The whole number of scholars in residence for the academic year 1908–9 is therefore 178. These are distributed as follows among the colleges: 15 at Balliol, 14 at Christ Church, 13 each at Exeter and Queens, 12 at St. John's, 11 each at Hertford, New College and Worcester, 10 each at Merton and Wadham, 9 at Oriel, 8 each at Lincoln and Pembroke, 7 each at Brasenose, Trinity and University, 6 at Magdalen, 4 at Jesus and 2 at Corpus. There are, in addition, 11 ex-scholars in residence for the October term, engaged either in teaching, research or special study for examination. The total so reached of 189 is the highest point in numbers hitherto attained. The work of the scholars now in residence is distributed as follows over the different courses of study organized in the university: Literæ Humaniores, 20; natural science (geology, chemistry, physiology and physics), 18; jurisprudence, 38; history, 20; mathematics, 4; theology, 9; English literature, 7; oriental languages, 1; modern languages, 4; Honor Moderations—classical, 3.

THE DARWIN CENTENARY

In addition to the exercises in New York, Philadelphia, Chicago and elsewhere in honor of the hundredth anniversary of Darwin's birth, which have already been noted in Science, memorial exercises were arranged by several other institutions.

At Cornell University the event was commemorated by two lectures by Professor J. H. Comstock on "The Basis of the Theory of Evolution," a lecture on "The Relation of Darwinism to the Modern Theories of Evolution," by Professor Herbert J. Weber, and an address by President Schurman on "Darwinism and Modern Thought."

At a special meeting of the Scientific Association of the University of Missouri, held on February 12, in commemoration of the

one hundredth anniversary of Darwin's birth and the fiftieth anniversary of the publication of the "Origin of Species," the following addresses were delivered: "Biographical Sketch of Darwin," by Professor W. C. Curtis; "Darwin's Contribution to Evolution," by Professor C. Stuart Gager; "Pre-Darwinian Evolution," by Professor A. O. Lovejoy; "Post-Darwinian Evolution," by Professor George Lefevre; "The Influence of Darwin's Work on Ethics," by President A. Ross Hill; "The Influence of Darwin's Work on Sociology," by Professor C. A. Ellwood; "The Influence of Darwin's Work on Psychology," by Professor Max Meyer; "The Influence of Darwin's Work on Theology," by Rev. Dr. W. W. Elwang. Mr. F. A. Sampson, secretary of the State Historical Society of Missouri, read a most interesting series of letters written by Darwin about 1878 to Mr. R. A. Blair, of Sedalia, Missouri, concerning what was at first supposed to be a case of the inheritance of a mutilation in a flock of geese.

ON Thursday evening, February 11, Dr. J. M. Reade, of the University of Georgia, delivered a lecture on "Charles Darwin," before the University Club. Commemoration exercises were held at the home of Professor H. C. White, of the University of Georgia, on Friday, Feb. 12, in honor of Darwin. The program consisted of: "Biographical Sketch," by Dr. H. C. White; "Organic Evolution," by Dr. J. P. Campbell; "Evolution in History," by Dr. J. H. T. McPherson; "The Church and Evolution," by Rev. Troy Beatty.

A SPECIAL meeting of the Boston Society of Natural History was held on the evening of February 12, in commemoration of the centenary of Charles Darwin's birth and of the fiftieth anniversary of the publication of his "Origin of Species." After introductory remarks by Vice-president R. T. Jackson, the following brief addresses were made: By Profesor W. H. Niles on the "Early Life of Darwin and his Contributions to Geology"; by Professor E. S. Morse on "The Factors of Darwinism"; by Professor G. H. Parker on "A Mechanism for Correlated Characters," and by Professor W. M. Wheeler on "Pre-Darwinian and Post-Darwinian Biology."

AT the general meeting of the American Philosophical Society on the evening of Friday, April 23, a Darwin celebration will be held. Charles Darwin and his grandfather, Erasmus Darwin, were members of the society, and his son, Sir George Darwin, is at present a member. On this occasion there will be three special addresses by members of the society: The first by the Right Hon. James Bryce, the British ambassador, who will give some personal reminiscences of Darwin and of the impression made by the appearance of the "Origin of Species" in 1859; the second by Professor Goodale, of Harvard University, on "The Influence of Darwin on the Natural Sciences," and the third by Professor James Mark Baldwin, of Johns Hopkins University, on "The Influence of Darwin on the Mental and Moral Sciences."

SCIENTIFIC NOTES AND NEWS

PROFESSOR CHARLES B. RICHARDS, professor of mechanical engineering at Yale University since 1884, and Dr. W. G. Sumner, professor of political and social science since 1872, will retire from active service at the close of the present academic year.

THE Rumford Committee of the American Academy of Arts and Sciences has recently made the following grants: To Director W. W. Campbell, of the Lick Observatory, $250, for the purchase of a Hartmann photometer; to Professor R. W. Wood, of the Johns Hopkins University, $150, in aid of his research on the optical properties of mercury vapor.

MR. O. J. R. HOWARTH has been appointed assistant secretary of the British Association in succession to Mr. A. Silva White.

SIR DANIEL MORRIS, K.C.M.G., late British commissioner of agriculture for the West Indies, has been selected for the newly-created office of scientific adviser to the secretary of state for the colonies on matters relating to tropical agriculture.

DR. R. PILGER has been appointed custodian of the Botanical Garden in Dahlem, Berlin.

THE committee of the Athenæum Club has elected, under the provisions which empowers the annual election by the committee of nine

persons "of distinguished eminence in science, literature, the arts, or for public services," Mr. Horace T. Brown, F.R.S., LL.D., and Sir David Bruce, F.R.S.

Sir William White was the guest of the Sheffield Society of Engineers and Metallurgists at their biennial dinner on February 26.

Dr. F. A. Dixey has been elected president of the Entomological Society of London.

Professor Ramón y Cajal, of Madrid, and Professor Emil Fischer, of Berlin, have been elected honorary members of the Paris Biological Society.

A Swiss Neurological Society has been formed, the headquarters of which are at Zürich and the first president of which is Professor von Monakow.

We learn from *Nature* that Dr. F. H. Hatch has been appointed by the government of Natal to make an examination of the mineral resources of the colony, and will shortly proceed to South Africa for that purpose.

Dr. Sven Hedin lectured before the Royal Geographical Society on February 7, and proposed to give a number of lectures in England in the course of the following month on "My Recent Expedition in Tibet."

Convocation Day was observed by the University of Pittsburgh on February 12, Lincoln's birthday. An address was made by Colonel Samuel Harden Church upon Lincoln, by Dr. W. J. Holland upon Darwin, and by Dr. J. A. Holmes, of the United States Geological Survey, upon "The Conservation of Our National Resources." Vice-president-elect James S. Sherman was present and made a brief address. The honorary degree of LL.D. was conferred upon Hon. James S. Sherman, Colonel S. H. Church and Judge William Waugh, of Greenville, Ohio, who graduated from the university seventy years ago in the class of 1839. The degree of Sc.D. was conferred upon Mr. F. A. Lucas, curator-in-chief of the Brooklyn Institute of Arts and Sciences, Dr. J. A. Holmes, of the United States Geological Survey, and Mr. Edward Goodrich Acheson, the electrical engineer.

A sum of over $10,000 has been subscribed to a monument to be erected in honor of Berthelot, the eminent chemist.

Dr. Carroll D. Wright, the first president of Clark College, U. S. Commissioner of Labor from 1885 to 1905, president of the American Association for the Advancement of Science in 1904, eminent for his contributions to statistics and sociology, died at Worcester, Mass., on February 20, at the age of sixty-eight years.

Dr. Ernest S. Wheeler, lecturer on tropical medicine in the Dartmouth College Medical School, died on February 15, at the age of forty years.

At the suggestion of the North American Conference on the Conservation of Natural Resources, in session in Washington last week, President Roosevelt has determined to issue, through the state department, invitations to all nations to send delegates to an international conference on conservation, to be held at The Hague.

Mr. Andrew Carnegie has given $100,000 for branch buildings to the Cincinnati public library.

Dr. George Gore, F.R.S., formerly lecturer on chemical and physical science at King Edward's School, Birmingham, who died on December 20, aged eighty-two years, left an estate valued at £6,802. The testator left £500 in personal bequests and £100 to the Birmingham University. All his other property he left equally between the Royal Society and the Royal Institution of Great Britain.

The Gordon Wigan income for 1908 at the disposal of the Special Board of Biology and Geology, of Cambridge University, has been applied as follows: (*a*) £50 to D. Sharp, M.A., the curator in zoology; (*b*) £50 to A. G. Tansley, M.A., to enable the Botanic Garden Syndicate to continue to offer special facilities for plant-breeding experiments; (*c*) £50 to Professor Hughes, being £30 for the purchase of a projection lantern for the geological department and £20 for the expenses of research on Pleistocene deposits in the neighborhood. The prize of £50 from the fund for

an investigation in chemistry was awarded to Leonard Angelo Levy, B.A., Clare, for his essay entitled "Investigations on the fluorescence of Platinocyanides." Grants out of the balance on income account amounting to £180 were made to the departments of physics, mineralogy and engineering, to defray the cost of special apparatus.

BY arrangement with the Bermuda Natural History Society, the Station for Research at Agar's Island will be open for about seven weeks this summer. There are accommodations for a limited number of instructors or research students in either zoology or botany. Members of the expedition will sail from New York on one of the steamers of the Quebec Steamship Company's Line (probably the *Bermudian*) about the middle of June, or, for those who can not sail so early, about the first of July. Further information may be obtained from Professor E. L. Mark, 109 Irving Street, Cambridge, Mass.

A PLAN of cooperation between the United States Bureau of Plant Industry and the department of pharmacy of the University of Wisconsin has been adopted, the purpose of which is to provide for the cultivation of medicinal plants. Investigation and research work is to be carried on in connection with the growing of those plants used in the preparation of drugs and medicines.

A TUBERCULOSIS exhibit consisting of the Wisconsin exhibition at the International Tuberculosis Congress, together with reproductions of the best features of all the other exhibits at that congress, has been prepared by the department of bacteriology of the University of Wisconsin and the Wisconsin Anti-Tuberculosis Association, and is to be sent out to cities throughout the state by the university extension division of the state university. The exhibit shows in graphic and striking forms the great losses resulting from the ravages of tuberculosis, the best preventive measures and the most effective and economical means of cure. An experienced demonstrator will be in charge of the exhibit to explain the various charts, doors of houses, sleeping bags, window tents, photographs, etc.

DR. J. O. WAKELIN BARRETT and Dr. Warrington Yorke, members of the Blackwater fever expedition of the Liverpool School of Tropical Medicine, who went out to Nyasaland in August, 1907, have returned. The London *Times* states that the expedition was well provided and equipped for pathological and chemical research, and during their fourteen months' operations the investigators had unusual opportunities for studying the fever. According to their report, nearly all the cases occurring in the protectorate came under their observation. Every assistance was afforded the expedition by the government medical staff and the Shire Highlands Railway Company, the latter granting special facilities for the use of the line, which was a matter of great importance, seeing that the majority of attacks of blackwater fever occurred in the vicinity of the railway. The fever, however, is usually most prevalent during the rainy season, when means of communication are more or less interrupted, and movement from place to place is difficult. Hence the members of the expedition sometimes had to travel in extremely heavy rain, but even that was found preferable to the intense heat of the midday sun by the river. The expedition, the cost of which was met equally by the Colonial Office and the Liverpool School of Tropical Medicine, was from time to time in touch with the expedition sent out by the school nearly two years ago for the study of sleeping sickness in northeast Rhodesia and the south of Lake Tangányika. The school has also a yellow fever expedition in Brazil and a malaria expedition in Jamaica.

THE Belgian Permanent Committee on Human Alimentation, which was founded on the occasion of the International Congress on Food held at Ghent in 1908, held, as we learn from the *British Medical Journal,* its first meeting at Brussels on December 23, 1908, under the presidency of Dr. A. J. J. Vandervelde, of Ghent. Among the objects aimed at by the committee are the organization in Belgium of congresses on food, and the par-

ticipation of that country in international congresses on the same subject, the study of questions relating to the prevention of fraud, the supervision of the sale and manufacture of food preparations, and the promotion of uniform international methods of analysis. The committee will also investigate the question of human food from the chemical, physiological, technical, commercial, legislative, economic and social points of view. The committee consists of fifty members representing the scientific as well as the industrial and commercial worlds. There are three vice-presidents: MM. Libotte, of Antwerp; Sohier, of Liége, and Professor van Laer, of Brussels. Dr. Schoofs, of Liége, is general secretary.

A FRIEND of the *Scientific American*, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it. No essay must be longer than 2,500 words. Each essay must be typewritten, bearing only the pseudonym. With the essay should be sent a second plain sealed envelope, also labeled with the pseudonym and be sent to "Fourth Dimension Editor, *Scientific American*, 361 Broadway, New York, N. Y.," by April 1, 1909. Professor Henry B. Manning, of Brown University, and Professor S. A. Mitchell, of Columbia University, will be the judges.

ACCORDING to a special press bulletin prepared by Waldemar Lindgren, of the U. S. Geological Survey, the gold-mining industry of the United States had a prosperous year in 1908, in spite of adverse conditions of trade and finance. The director of the mint estimates the production of gold for 1908 from domestic sources at $96,313,256, against $90,435,700 in 1907. South Dakota, Alaska, California and Colorado show large estimated increases, ranging from $2,000,000 to $3,600,000. The estimates for Utah indicate a decrease of about $1,200,000; for Nevada a decrease of $3,300,000. The production of Montana, Arizona, Idaho, Oregon and other silver-producing states has remained approximately stationary. The production from the Philippine Islands shows an increase, the estimate of the mint being $306,708, against $78,700 in 1907. As part of the Philippine gold does not reach the United States mints the showing is probably even better than these figures would indicate. Most of the gold was recovered by quartz mining in Benguet and by dredging operations in Paracale. The silver-mining industry presents a far less satisfactory condition than that of gold, owing to the low prices for silver, lead, copper and zinc. During the year the large smelters of Utah and Colorado were partly closed and partly operated on a reduced capacity.

THE following lectures will be delivered at Columbia University on The Henry Bergh Foundation for the Promotion of Humane Education, 1908–9, Wednesdays at 4.10 P.M., in Room 309 Havemeyer Hall:

February 3—"The Influence of Humane Ideals and Practises in Human Civilization," by Franklin Henry Giddings, Ph.D., LL.D., professor of sociology and the history of civilization, Columbia University.

February 10—"Pure Food as an Element in the Humane Treatment of Men and Animals," by H. H. Wiley, Ph.D., of the Department of Agriculture, Washington, D. C.

February 17—"The Humane Treatment of Animals," by Albert Leffingwell, M.D., of Aurora, N. Y.

February 24—"Science and Animal Experimentation," by Nathan Oppenheim, M.D., of New York.

March 10—"Hunting with the Camera," by George Shiras, 3d, of Washington, D. C.

March 17—"The Humane Treatment of Children," by Homer Folks, secretary of the New York State Charities Aid Association.

March 24—"The Humane Treatment of Criminals," by Samuel J. Barrows, D.D., president of the International Prison Commission.

March 31—"The Ethics of Punishment," by John Dewey, Ph.D., LL.D., professor of philosophy in Columbia University.

April 7—"The Economic Aspect of the Humane Treatment of Children and Animals," by Roswell C. McCrea, Ph.D., of the New York School of Philanthropy.

PROFESSORS MORTON PRINCE and George V. N. Dearborn, at the Tufts College Medical School, Boston, offer a course on psychopathology, required for fourth-year students of medicine. The course, which is said to be the first of the kind, will cover the following topics:

Mental physiology.—Mechanism of memory, including physiological (unconscious) memories (spinal cord and ganglia). Meaning of the unconscious. Formation and conservation of unconscious complexes. Meaning of the subconscious and co-conscious. Integrative action of the nervous system. Habit-formation. Emotion. Influence of psychical processes on the functions of the viscera (digestive, vasomotor, secretory, respiratory systems, etc.). Cenesthesia. Hypnosis (theory and phenomena). Suggestion. Idea-complexes.

Dissociations of the mind.—Anesthesia. Paralysis. Amnesia. Abstraction. Hypnoidal states. Sleep. Trance states. Fatigue. Subconscious ideas and their activity. Unconscious processes. Abulia.

Syntheses.—Sensory automatisms (visual and auditory hallucinations). Paresthesiæ. Pain. Motor automatisms (spasms, contractures). Recurrent mental states. Obsessions. Impulsions. Fixed ideas. Delusions. Unconscious mental complexes and their influences. Dreams.

Special pathology.—Neurasthenia. Hysteria. Psychasthenia. Hypochondriasis. Phobias. Habit psychoses and neuroses. Mimicry. Psycholeptic attacks. Recurrent sensorimotor attacks. Amnesic states. Dissociated personality. Fugues. Tics.

Methods of examinations besides the ordinary clinical methods.—Psycho-analysis. Abstraction. Hypnoidization. Hypnosis. Automatic writing. Artificial hallucinations. Psychogalvanic tests. Word reaction tests.

Principles of psychotherapeutics based on psychopathology.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Virginia has completed an endowment fund of $1,000,000 of which half has been given by Mr. Andrew Carnegie.

THE educational commission which has for the past two years been codifying and revising the school laws of Pennsylvania, has created Colleges of Education at the Universities of Pennsylvania and Pittsburgh. These colleges will have as their specific functions the training of high school and normal school teachers, principals and superintendents of schools, supervisors of the various school grades, supervisors of special branches, and experts for service in the public school system of the Commonwealth. The code provides that the state shall pay the tuition of Pennsylvanians who are normal school graduates or who have successfully completed the sophomore year of a college. While no state aid is asked at the present session, it is provided that the legislature may make special appropriations for buildings, equipment and other needs of the Colleges of Education as from time to time may be deemed necessary.

IN accordance with the principles of university nomenclature adopted by the Association of American Universities, the University of Wisconsin has changed the title of the college of law to that of "Law School," and the name of the college of medicine was changed to that of "Medical School"; the recommendation of the Association of Universities being that the term "school" be applied to those professional departments requiring for admission at least two years of college work.

ON February 15 the University of Nebraska celebrated the fortieth anniversary of the granting of the charter under which the institution was organized. The address was given by Dr. Ellery W. Davis, dean of the College of Literature, Science and the Arts, on "A Coming Aristocracy."

THE scheme prepared by the charity commission under the will of the late Mr. John Innes, of Merton, has now been settled. The most important part relates to the institution of a national horticultural college at Merton.

THE Italian minister of education, Signor Rava, has pledged himself to the restoration in its integrity of the University of Messina, promising the students that it shall not be transferred elsewhere. Attention has been called to the fact that in view of the 16 other state universities, of which two are in Sicily—at Palermo and Catania—this concession to passing sentiment is to be deplored as only adding needlessly to the complications of the revival of Messina.

Dr. James Burrell Angell submitted his resignation of the presidency of the University of Michigan on February 17, to take effect at the close of the academic year, and the board of regents created the office of chancellor and offered it to him at a salary of $4,000 a year with the continued use of the president's house. Dr. Angell, who on January 7 last celebrated his eightieth birthday, has been head of the university since 1871, when he came from the presidency of the University of Vermont.

The methods by which even our best daily papers are edited are illustrated by the fact that the New York *Sun,* on February 18, contained an article, the headlines of which announced that the presidency of the University of Michigan had been offered to Professor Jenks, of Cornell University, whereas in the article itself it was stated that no selection had been made. The New York *Times,* of February 20, contained an editorial article congratulating Professor Finley on his call to the presidency of the University of Michigan, and expressing hope that he would not go, especially on account of his admirable after-dinner speeches, whereas the news columns contained the statement that President Finley had denied that such a call had been made.

It is announced that Miss Agnes Irwin will resign the deanship of Radcliffe College at the close of the present academic year.

At Yale University, Professor L. P. Breckenridge, of the University of Illinois, has been appointed professor of mechanical engineering and Dr. W. R. Coe has been promoted to a full professorship of biology.

The council of New York University announces the appointment of J. Edmund Woodman as professor of geology and director of the geological museum, to fill the vacancy caused by the retirement of Professor John J. Stevenson; and of Holmes Condict Jackson to be professor of physiology and director of the laboratory of physiology in the University and Bellevue Hospital Medical College, to fill the vacancy caused by the resignation of Professor Graham Lusk. Professor Woodman received the degree of doctor of science from Harvard in 1904 and is now professor of geology at Dalhousie University, Halifax, Canada. Professor Jackson received the degree of doctor of philosophy from Yale University in 1899, and was instructor in physiological chemistry in the Sheffield Scientific School for three years. After study abroad he received an appointment as instructor in physiological chemistry in New York University, and became assistant professor in 1903. In 1905 he resigned to accept a position as adjunct professor in experimental physiology and physiological chemistry and director of the laboratories in the Albany Medical College, which position he now holds.

R. H. Whitbeck, of Adelphi College, Trenton, N. J., has been appointed associate professor of geography and physiography at the University of Wisconsin, beginning with the next academic year.

Sir T. H. Holland, F.R.S., director of the Geological Survey of India, has accepted the offer of the chair of geology at Manchester University vacated by Professor Boyd Dawkins, F.R.S. Dr. W. H. Lang has been appointed Barker professor in cryptogamic botany and Dr. Marie C. Stopes special lecturer in palæobotany.

DISCUSSION AND CORRESPONDENCE

APPOINTMENTS IN COLLEGES AND UNIVERSITIES

To the Editor of Science: It has for several years been a question of absorbing interest to me whether our American methods of making university appointments might not be much improved, especially in view of the fact that much better methods are in operation in other countries. It was a pleasant surprise to me to notice that others were agitating the same question, as is made evident by the discussion begun by Professor Wenley and continued by Professor Miller in Science of August 21 and October 23, respectively. It seemed to me that the time was ripe for some action on this matter. I therefore seized the opportunity of presenting my views

to my colleagues of the Chicago Section of the American Mathematical Society, assembled in an informal way at a dinner on January 1, in connection with the regular meeting of that body. I enclose a copy of the remarks which I made upon that occasion. Let me supplement these remarks with the statement that a committee of the Chicago Section has been appointed to investigate the matter more closely and to report at the next meeting. The committee consists of Messrs. T. F. Holgate (Northwestern), E. B. Van Vleck (Wisconsin), L. E. Dickson (Chicago), A. G. Hall (Michigan) and E. J. Wilczynski (Illinois).

Mr. Toastmaster and Gentlemen: It is a difficult task which I have to fulfill to-night, to hold your attention after a hard day's work of mathematical deliberation, at a time when the average man seeks repose in friendly conversation. But I shall not attempt to excuse myself, and hope that you will pardon this rather unusual proceeding on account of the interest and the importance of the subject.

We have come together as mathematicians, but most of us are at the same time men in academic life and as such are naturally eager to examine our existing institutions, to inquire whether they are the best conceivable under the circumstances, and if not, to attempt to improve them.

I doubt whether it is necessary for me to spend much time upon an attempt to convince you that all is not as it should be in our American methods of university appointments. We all know of cases where these methods have failed to accomplish the best results, namely, to secure the best man available at a given time for a position then open.

Many of our universities and colleges make honest efforts to solve this problem for themselves, and would probably welcome any movement which would assist them in its solution. Others are indifferent, while still others almost openly practise favoritism of the rankest kind. Many of our smaller institutions rely to a considerable extent upon recommendations made by larger and more influential universities, and the latter have a tendency, quite pardonable under our system, of recommending only their own graduates. Again many of these same universities in filling vacancies in their own staff, never would consider a candidate unless he had been one of their own students. The question of personal acquaintance counts too much; whether a man is a good fellow, or a man of conservative political and religious beliefs, whether his personal appearance is prepossessing, or whether his social attainments render him desirable, all of these questions are quite frequently weighed more carefully in the balance than these others: is the man a scholar, and can he teach? If he *is* a scholar, unless he has some good friends to speak for him, the presumptions are all against him. It is assumed almost as a matter of course that he can not be also a good teacher, and it seems practically certain that he can have no executive ability. Unless the photographer has been especially kind to him, his looks will probably not be satisfactory.

To return, for a moment, to the question of teaching ability; this is certainly one of the important points to be considered in the making of many and perhaps most appointments. But what methods have we for obtaining any positive or reliable information on that point? I think you will all admit that in most cases the evidence on that score might as well be dismissed; it usually consists of the statement of a few persons who may or may not be qualified to judge, and who may or may not know anything about the qualifications of the candidate as a teacher.

I wish to pass in review, rapidly, the methods employed in other countries in making university appointments, so far as I have been able to discover them.

The German system is fairly familiar. The faculty concerned makes recommendations to the minister of public instruction. There is no systematic and public canvass for the purpose of ascertaining the best man; the responsibility of making the recommendation is not fixed upon any particular man or group of men, but upon the faculty as a whole. Since the deliberations of the faculty are not public, any criticism of an appointment once made can not with any degree of certainty be directed toward any particular member of that body. While the system is, I believe, far better than our own and has in most cases given good results, it has often worked great injustice, making possible discriminations for personal or other reasons which under a better system might have been avoided.

I wish I could speak to you about an English system. But my attempts to find out about it have only led me to conclude that no such thing exists. Each of the universities in Great Britain apparently has its own methods of procedure in selecting its officers of instruction; each of the colleges which forms a part of the university again

has a different system, and the methods vary considerably even within the same institution for appointments of different grades. My source of information, one of the professors of Cambridge University, assures me that it would be a very formidable task to attempt to enter upon a comparative study of the methods of appointment in the English universities. Speaking of Cambridge, he says: "Certainly, for any trustworthy information about this place, a small pamphlet (perhaps it might not be small) is required." Under these circumstances, I feel compelled, in my discussion, to cross the channel to France, where a very simple and effective method is in operation.

The instructing staff of a French university is composed of professors (professeurs titulaires), chargés de cours, whom we shall here call assistant professors for the sake of convenience, and maîtres de conferences, whom we shall call instructors. The latter conduct their courses under the direction of a professor, the subject being frequently assigned to them by such a professor. The assistant professor conducts his course independently, being temporarily in charge of a professorial chair; he therefore plays the part of a professor without having professorial rank. A limited number of these assistant professors may be appointed professeurs-adjoints (let us say associate professors). This distinction affects neither the character of their work nor their salary, but merely gives them the right to take part in the deliberations of the council of the faculty. This council, composed of the professors and associate professors, has jurisdiction over a number of questions in which the faculty is interested, among others those concerning appointments. An associate professor, however, has no right to vote on the appointment of a full professor. Certain other matters are decided by the whole faculty (Assemblé de la Faculté), composed of all of its members, including also the instructors.

If a professorial chair in a French faculty of science is vacant, the council of the faculty may or may not declare officially the existence of a vacancy, after which the chair is filled temporarily for a period of varying length by a chargé de cours. The minister of public instruction then inquires of the council whether it wishes the chair to be maintained, suppressed or transformed. If the chair is maintained or transformed, the candidates, who must be at least thirty years of age and in possession of the doctor's degree, are given twenty days to hand in their applications, publications, recommendations, etc. After the expiration of this period the faculty presents a list of two names (first and second choice) to the minister of public instruction. But there exists a body called "Section permanente du Conseil supérieure de l'Instruction publique," composed of a number of scholars and high officials of the ministry of public instruction. This committee likewise presents a list of two names to the head of the department of public instruction, who may legally choose either name on either list. It is possible, therefore, that the new professor may not be one of those requested by the faculty. But such cases are very rare and arouse violent protests when they present themselves. Generally the first choice of the faculty is appointed.

There is no law requiring the minister of public instruction to consult the faculty in the appointment of assistant professors and instructors. As a matter of fact, however, this is always done, and except in one or two cases the wishes of the faculty have always been respected.

This system, which has some strong points, has given satisfaction. Still it does not seem to differ very materially from the German method, and seems to me to be much inferior to the Italian, which I shall now proceed to describe.

If a professorship in an Italian university is to be filled, the fact is advertised a long time beforehand in the official journal of the department of education, notices to this effect being also posted on the bulletin-boards of the various universities throughout the kingdom, as well as in other appropriate places. Anybody who thinks that he has any claim upon the position may apply. His application must be handed in by a certain date. It must include an account of his previous career, accompanied by the proper documents, diplomas, etc., a list of his publications and five copies of as many of these as possible. Most of the other documents are also required in five copies, for a reason which will immediately become apparent.

In the meantime the faculties of all of the universities of the kingdom are asked by the minister of public instruction to present him with a list of five men, these to be members of a committee whose purpose it shall be to judge the applications and to make a nomination. Each of the universities thus registers its choice as to the five men whom it considers the most competent judges in the case. They are, naturally, all specialists in the subject of the vacant professorship or else in closely allied subjects. These lists of five are again printed in the official journal. Five of the ten men who receive the highest number of

votes, the vote of each university counting as one, are then chosen by the minister of public instruction as members of the committee.

The responsibility for a selection now rests upon this committee. Each of the members individually examines the applications, and considers the relative merits of the candidates. Finally the committee meets as a whole in Rome and decides upon a first, second and third choice for the position. The minister of public instruction offers the position to the first choice; if he refuses, to the second, etc.

This system seems to me to eliminate, about as completely as any human contrivance may, the chances for injustice in an appointment. The complete publicity which attends the various steps in the proceedings, the fixing of the responsibility for a recommendation upon a committee of five of the most representative men of their profession, the democratic and in every way admirable manner of selecting these men, seem to give an absolute guarantee of the wisdom of the final choice. In fact it has worked admirably in practise, and it seems to me that this Italian system is the one which we ought to attempt to adapt to our needs in this country.

Gentlemen, I hope that the discussion of this evening will bear some fruit. If in our country there existed a central authority controlling all of our universities, we might make an effort to have such a system of appointments introduced by law. We are compelled to resort to a slower process, that of forcing a gradual change from our present methods by educating public opinion. But we are members of a great national organization, the American Mathematical Society, and I am going to ask you to support a motion to appoint a committee to investigate the possibility of improving the methods of appointments in our colleges and universities as far as mathematicians are concerned. I hope that you will support the motion; I hope that this committee will find a satisfactory solution of the problem, and that finally other national learned societies will follow our example, so as to improve the status of the American professor not only in mathematics, but in all other subjects.

To show you more in detail what kind of questions such a committee might investigate, I will give a few examples. Do not misunderstand me. I am not attempting to legislate for the committee, I do not hold tenaciously to any of the propositions which I am now going to advance. Their only purpose is to show that there are certain features of this problem which a society like ours can attack with some degree of success, and which would form a legitimate, if difficult, portion of its work.

Would it not be desirable, for instance, if every mathematical vacancy occurring in any of our colleges or universities were advertised in the *Bulletin*, accompanied by a statement of title and salary, grade, character and amount of work, as well as the date of appointment? It may seem very difficult, but may it not be possible to devise a scheme by means of which the society could put at the service of any institution requesting it, its advice in regard to the filling of any particular position? This might be done by means of a committee appointed for this purpose from year to year, or as in the Italian system for the making of one particular appointment. Several such committees might be appointed for the different regions of our country, whose vastness, of course, is one of the great difficulties to be overcome in the working out of such a system.

I have tried your patience long enough. I shall be satisfied if I have convinced you of the wisdom, not of any of the particular things which I have mentioned, but of the general policy of taking this matter under consideration. It is my honest opinion that the American Mathematical Society can render signal service to the cause of education and science in this manner. I feel convinced that it is our duty as free and independent men, as citizens of the academic world to take this step, which may lead toward a better condition of affairs, where merit will receive its just reward, where all proceedings will be open and frank, where there will be no place for incompetence and injustice.

E. J. WILCZYNSKI
THE UNIVERSITY OF ILLINOIS

GENERA WITHOUT SPECIES

NOTWITHSTANDING the great value of the International Code of Zoological Nomenclature, and the care with which it has been compiled, there remain several important points upon which those professing to follow the code are disagreed. In part, these are due to deliberate omissions, resulting from the impossibility of securing unanimity; but some of them are supposed to be covered by the code, and yet opposite interpretations are made by good authorities. Probably the most serious question of the latter sort relates to generic

names proposed without any definite mention of species to be included under them. The controversy over "genera without species" is especially agitating entomologists at the present moment, because of a proposal to bring into use a number of names for the most common genera of flies, and thus greatly disturb the nomenclature of dipterology. Professor Aldrich has ably contended against this proposal, fortifying his opinion with the code; but another very eminent dipterologist reaches exactly the opposite result, also using the code.

The matter is one which concerns all zoologists and botanists, and whatever may be the ultimate decision regarding it, it will be generally admitted that it is of the highest importance to determine current opinion, as a step toward securing unanimity. With the editor's permission, I will ask for a post-card vote from working zoologists and botanists, and will publish the lists of names in SCIENCE. The vote is asked on the question whether a generic name published without any mention of included species is to be regarded as valid, even though it is accompanied by a definition or diagnosis.[1] It has seemed to me that names so published were rejected by the code, because article 25 states that one of the conditions of the validity of a generic name is "that the author has applied the principles of binary nomenclature." This means, as I understand it, that he must not merely believe in those principles, or apply them elsewhere, but he *must apply them to the case in hand,* to the proposed new genus. If this is correct, I am totally unable to see how he can do this without designating any species by name. In absolute strictness, he ought not merely to designate an included species, but also make the proper combination with the generic name. This is recommended by the present code, but not made obligatory.

Those who take a different view, support their contention by reference to article 2 of the code, which states that "the scientific designation of animals is uninominal for subgenera and all higher groups." This, it seems to me, merely states the obvious fact that the names of subgenera, genera, families, etc., are single words; it does not appear to offer any opinion as to the proper manner of publishing the various designations. Who can define a genus, except as including species; a family, except as including genera; an order, except as including families? It is not possible to upset our fundamental conceptions of these things, any more than it is possible to write sentences without words, words without letters of the alphabet. A genus without species has no type, no content, and apparently has no place in our systems of classification.

On the other hand, various generic names, first proposed without any designated species, have later been given full validity by the designation of specific types, and the publication of the necessary combinations. Some writers have held that when the first mention of an included species was made by some author other than the original one, the generic name should be credited to the author citing or describing the species. I think this should not be strictly necessary, but that while the generic name must be dated from the later publication, it may properly be credited to the original writer, whose work may be considered to be included and republished in the validating work. This is a matter on which opinions will differ, and as it does not affect the names themselves, it is not of the first importance. Another difficult class of cases is that in which a generic name has been proposed with the name of an undescribed species. The late Dr. Ashmead has left us a large number of such genera. If the genus was also without definition, both generic and specific names would be nomina nuda; but I have ventured to hold that any diagnosis of the genus might also be interpreted as a diagnosis of the species (only one being mentioned), and hence both generic and specific names would be available for adoption.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO,
BOULDER, COLO.

[1] This does not include names proposed (on account of preoccupation) to replace others which already have included species. Such cases are covered by the code.

DR. WILLISTON ON "THE FOSSIL TURTLES OF NORTH AMERICA"

IN SCIENCE of December 4, 1908, Dr. S. W. Williston has published a review of my book, "The Fossil Turtles of North America." This review showed as much appreciation of the merits of the book, and as much leniency towards its shortcomings, as its author could desire. However, one or two matters referred to by Dr. Williston seem to require notice; and this is here respectfully presented.

Dr. Williston takes issue with my division of the turtles into the Athecæ and the Thecophora. To this I will say that unless the early turtles separated primarily into the ancestors of the two groups mentioned, these two suborders are not at all worthy of recognition.

As to the resemblances between the leather-back and the other sea-turtles, I will, to illustrate, consider the flippers. The limbs of the primitive turtles were, I believe, not greatly different from those of the snapper, for example. Inasmuch as the ancestors of the leather-back and those of the other sea-turtles started with the same form of fore limb and on entering the water employed this limb in the same way, it is not strange that their descendants have closely similar flippers. The fore limbs of the Trionychidæ have certainly been independently developed, and yet they are being modified in the same direction. Those of *Carettochelys* are another example. If a thoroughly aquatic pleurodire shall ever be discovered it will doubtless have similar fore limbs.

As regards the two dermal coverings of the primitive turtles, I may remark that the early reptiles probably had as great need of armor as their modern descendants. A modern crocodile seems to have need of only a single layer of dermal bones, the so-called abdominal ribs, in the lower wall of its belly; but a cayman requires, in addition to this, an armor of closely jointed bony scutes. The leather-back itself actually possesses the two bony coverings in question. Ventrally the plastron of dermal bones is covered by rows of osseous scutes, while on the upper surface the nuchal bone is found to be overlaid by a portion of the mosaic-like bony armor. Who is to say that never were there under this mosaic of the upper surface also peripheral bones, and even costal plates?

Dr. Williston is certainly correct in holding that the elements that I have called fascia bones are of dermal origin. The dermal bones that had sunken beneath the skin I thus named, in order to distinguish them from a more superficial stratum.

As evidences for the existence of two dermal bony coverings in the primitive turtles I present for consideration the fact that the leather-back has as many longitudinal zones of bony scutes as the most generalized turtles have of horny shields, and the additional fact that the horny shields do not coincide with the bones which they overlie, but break joint with them.[1]

Dr. Williston says that "*Toxochelys* possesses neural ossicles, while the nearly related and less aquatic *Porthochelys* is without them." In like manner, the alligator snapper possesses a series of supramarginal horny shields, an ancient inheritance, while the common snapper has lost them. *Porthochelys* retained the nasal bones, but *Toxochelys* did not.

My friendly reviewer is in error when he states that I hold that in *Toxochelys* there are only vestiges of the inner layer of dermal bones. The nuchal, the costal plates (except that part belonging to the true ribs), the peripheral bones, and the whole plastron, belong to the inner layer.

Dr. Williston mentions the fact that I have omitted mention of two turtles that have got into literature. One of these is from the Dakota sandstone of Kansas, a formation that has furnished no other remains of the order. This specimen[2] is the cast of the cavity of the shell, with indications of some of the ribs. The relationships of the turtle are indeterminable and fortunately no name has been given the specimen. The other turtle referred to was originally briefly described by Dr. Willis-

[1] See *American Naturalist*, XXXII., 1898, pp. 929–948.

[2] *Trans. Acad. Sci.*, XVI., 1899, p. 67, pl. iv.

ton himself.[1] It had been discovered in the Benton beds of Kansas and is stated to consist of some fragmentary ribs and a part of a humerus. The species is supposed to be related to *Protostega,* but here again no name was imposed on the specimen. Dr. Williston pays me the compliment of regretting that I did not describe these materials, with which he could do little himself.

Oliver P. Hay

Washington, D. C.,
January 7, 1909

QUOTATIONS

AMMUNITION AGAINST THE ANTI-VIVISECTIONIST

As antagonism to vivisection is a form of incurable insanity, those who suffer from it are wholly indifferent to argument or facts, and their delusional convictions urge them irresistibly to constant repetition of the same mad acts, quite regardless of consequences to themselves or others. Hence is it that year after year these unfortunate people renew their efforts to secure legislative interference with or prohibition of the experiments with living animals upon which the progress of medical science depends and without which medical practise would be reduced to blind, or at least dim-eyed, empiricism.

That the anti-vivisectionists always find somebody to introduce their bills is a sad commentary on the intelligence of legislators, but this year, as so often before, the battle with well-intentioned ignorance must be fought again. There are now a few more triumphs over disease with which to confront the wild assertions and accusations of the agitators, but dependence must still be placed on arguments the adequacy of which has already been proved a hundred times—so often, indeed, that many of the same people whom they long since convinced have half forgotten essential parts of the evidence upon which the animal experimenters rely as a defense from the hampering restrictions that unreasoning sentimentalists would impose upon one of the most unselfish and successful classes of workers for the common good.

There is danger in this forgetfulness, and to meet it the Committee on Experimental Medicine of the New York State Medical Society has begun the publication of a series of leaflets setting forth clearly and briefly the scientific and medical side of the vivisection controversy. One by Dr. E. L. Trudeau deals with "Animal Experimentation and Tuberculosis," another by Dr. James Ewing takes up with cancer research, and a third by Professor F. S. Lee treats of "The Sense of Pain in Man and the Lower Animals." Dr. Simon Flexner's contribution tells what vivisection has accomplished in the war against infectious diseases, and Dr. S. J. Meltzer discusses "The Function of the Thyroid Gland—an Important Chapter of Modern Medicine." A leaflet of a different kind is one giving eminent lay opinions, among those quoted in it being ex-President Eliot, of Harvard; President G. Stanley Hall, of Clark University; President E. H. Capen, of Tufts College; Bishop William Lawrence, of Massachusetts, and Dean Hodges, of the Cambridge Theological School. Dr. William H. Park takes up the great subject of "Diphtheria," the disease which would still be slaying its thousands had it not been absolutely conquered through vivisection alone.

Copies of these and other leaflets can be obtained upon application at the Academy of Medicine, 17 West Forty-third Street. They are intended especially for physicians, but they are full of ammunition which anybody can use in answer to silly talk about the cruelty or the uselessness of a method of investigation which is neither the one nor the other, but is, on the contrary, one to which animals and men alike are incalculably indebted for relief from pain.—New York *Times.*

AN IDLE CHALLENGE

This characteristic communication comes to us from the president of the Anti-Vivisection Society:

To the Editor of The Evening Sun—*Sir:* Regarding your editorial attack in *The Evening Sun* of January 27 upon a leaflet issued by this society, I would say that I should be glad to have you attempt at our mass meeting (to be held at Car-

[1] *Kansas Univ. Quarterly,* I., 1902, p. 247.

negie Lyceum, February 3, 8 P.M.) to sustain your assertions against its accuracy. Miss Lind-af-Hageby will be glad to show you that you are in great error. Very truly yours,

DIANA BELAIS

New York, January 31.

We have received a similar letter from a woman who says she wrote the leaflet. She shall be nameless. It is typical of the light-hearted irresponsibility of the anti-vivisectionists that neither the woman who is responsible for the publication of the leaflet nor the woman who boasts of having penned it offers the least defense of her part in the matter. Instead we are told that a certain young woman from England "will be very pleased to meet any one in debate." This young woman, we may remark, was joint author of a scandalous publication entitled "The Shambles of Science," which the publisher was compelled to withdraw from circulation several years ago, with a public expression of "sincere regret for having printed and published the book in question." We have no desire to enter into any controversy with this woman, who confesses that she has some difficulty in finding opponents at debate in the country of her adoption—a circumstance which does not astonish us in the least.

Mrs. Belais boldly proclaimed the other day that no "unjustified assumptions or allegations" were published by her precious society. We picked up a leaflet and extracted this single passage: "Pasteur and his followers increased a very rare disease called rabies, and are making fortunes out of the anti-rabic virus." To call this an "unjustified assumption" is to state the case mildly. It is nothing less than an infamous and malicious lie. And we maintain that it is a disgusting spectacle to see so great a benefactor of the human race as Pasteur treated in this frivolous manner by a parcel of unscrupulous women.—New York *Evening Sun*.

SCIENTIFIC BOOKS

Biology and Its Makers. By WM. A. LOCY. With portraits and other illustrations. New York, Henry Holt & Co.

It was the purpose of the author of this book to give "an untechnical account of the rise and progress of biology" which "would be of interest to students, teachers, ministers, medical men and others"; "to bring under one view the broad features of biological progress and to increase the human interest by writing the story around the lives of the great leaders." "The portraits [82 in number] with which the text is illustrated embrace those of nearly all the founders of biology." The scope of the volume is best seen from its table of contents:

Part I.—The Sources of Biological Ideas Except Those of Organic Evolution. Ch. I. An Outline of the Rise of Biology and of the Epochs in its History. Ch. II. Vesalius and the Overthrow of Authority in Science. Ch. III. William Harvey and Experimental Observation. Ch. IV. The Introduction of the Microscope and the Progress of Independent Observation. Ch. V. The Progress of Minute Anatomy. Ch. VI. Linnæus and Scientific Natural History. Ch. VII. Cuvier and the Rise of Comparative Anatomy. Ch. VIII. Bichet and the Birth of Histology. Ch. IX. The Rise of Physiology—Harvey, Haller, Johannes Müller. Ch. X. Von Baer and the Rise of Embryology. Ch. XI. The Cell Theory—Schleiden, Schwann, Schultze. Ch. XII. Protoplasm and the Physical Basis of Life. Ch. XIII. The Work of Pasteur, Koch and others. Ch. XIV. Heredity and Germinal Continuity—Mendel, Galton, Weismann. Ch. XV. The Science of Fossil Life.

Part II.—The Doctrine of Organic Evolution. Ch. XVI. What Evolution is: The Evidence upon which it Rests, etc. Ch. XVII. Theories of Evolution—Lamarck, Darwin. Ch. XVIII. Theories Continued—Weismann, De Vries. Ch. XIX. The Rise of Evolutionary Thought. Ch. XX. Retrospect and Prospect. Present Tendencies in Biology. Reading List. Index.

This book is of much value and should be placed upon the shelves of all school libraries. Biologists will find it a convenient book of reference. Few readers will be so well informed that they will gain no information from its pages. Of especial value are the portraits, many of which are rare and unfamiliar.

The volume is a compilation. Its author makes free use of other studies in the same field, and accepts, for the most part, the gen-

eral judgment as to the men whose work he describes. These judgments and characterizations are occasionally rather naïvely expressed, but the reader is not often inclined to take exception to them, though in certain instances one must do so. For example: The somewhat extended reference to Ehrenberg's work on the protozoa and the very brief mention of Stein is hardly consistent with the fact that Ehrenberg's work, though extensive, was inaccurate and as a whole made no such valuable contribution to our knowledge of this group as did Stein. Richard Hertwig's influence upon the progress of protozoology has hardly been second to that of Bütschli. In the chapter upon classification no emphasis is laid upon the recognition of the sponges as clearly distinct from and sharply contrasted with all the other metazoa. In the discussion of advances in cytology no mention is made of the evidence that the male and female parents are equipotential heredity, nor is there any reference to the work of Richard Hertwig, Schaudinn and others upon the presence and behavior of generative and vegetative chromatin in the cell, though these subjects are surely as important as recent studies of cell-lineage and regeneration which are mentioned. One wonders if the author's confidence that vitalism is a wholly mistaken conception (p. 181) is justified. Are psychic phenomena chemical and physical?

The descriptions of the men and their work and place in the progress of biology are not so vivid as they are, for example, in Foster's "History of Physiology," but this doubtless is in part due to the greater scope of the book and its necessarily briefer treatment of each man and his period. The treatment impresses one not as masterful, but as faithful, and in general sound. In its reference to modern workers, American students receive disproportionate mention, but in a volume designed for American readers, this is perhaps not unnatural.

The second part, dealing with the doctrine[1] of evolution, is not so satisfactory as Part I. The author might have been more successful in his attempt to condense into brief statement the essential features of the theory. He might well have included reference to isolation as a factor in evolution, and perhaps, even in so condensed a treatment as this, organic selection might be mentioned. The presentation of Mendelism (p. 316) would hardly be clear to any one not already familiar with the subject. The statement (p. 389) that "sexual selection is almost wholly discredited by biologists" is of course a mistake. Probably all recognize its past importance among human kind, and some believe that it will in time become of greatly increased importance in human evolution.

A few inaccurate statements, and some of doubtful truth, might well be modified in a second edition. Weismann's theory of heredity was presented in his essays upon heredity some years before the appearance of his volume "'The Germ Plasm' published in 1893." Is it true that "Davenport, Tower and others have made it clear that species may arise by slow accumulations of trivial variations, and that, while the formation of species by mutation may be admitted, there is still abundant evidence of evolution without mutation?" It seems, on the contrary, increasingly probable that fluctuating variations do not form a basis for the evolution of new species. It is difficult to see the author's meaning in his statement (p. 404) that "neither mutation nor natural selection is a substitute for the doctrine of the continuity of the germ plasm," or in the statement (p. 405) that "the body cells are not inherited"; and we can not but object to the form of the statement (p. 406), that "natural selection presides over and improves variations arising from mutation," and to the last phrase in the sentence (p. 316). "In this country the experiments of Castle, Davenport and others with animals tend to support Mendel's conclusion and lift it to the position of a law." Sexual selection in the sense now accepted, though not in Darwin's usage, has no relation to the "law of battle" (p. 413). In view of evidence presented by Poulton in his address at

[1] Theory might be a better word, for the word doctrine carries with it, not logically but actually, a little of the flavor of the word dogma.

the Darwin celebration in Baltimore last Christmas, there is need of modifying the statement (p. 414) that "it is altogether likely that Lamarck was wholly unacquainted with" [Erasmus] "Darwin's work, which had been published in England." Charles Darwin lived at Downe not Downs.

Is it true (final chapter, p. 441) that experiments with "artificial fertilization by changes in osmotic pressure . . . have greatly altered opinions regarding the nature of fertilization, and of certain other phenomena of development," or (p. 442) that "recent advances in physiological chemistry have greatly widened the horizon of our view regarding the nature of vital activities"? Would not both statements be stronger if more modest in their claims for the results of recent research in these most important fields? It is doubtful if even in a popular book of this sort it is justifiable to attempt to state the duration of geologic periods in years (cf. p. 344–5).

One finds in the book some phrases and sentences whose form is not beyond criticism —(p. 443) "studies of a pathological character"; (p. 294) "sheep and other cattle"; (p. 383) "pigeons and other fowls"; (p. 429) Wallace is said to be "notable for the publication of important books, as the 'Malay Archipelago,'" etc.; the phrase "fossil life," is frequently used, once it appears as "fossil vertebrate life"; it seems strange (p. 337) to refer to Leidy, Cope and Marsh as "these gentlemen" instead of these men. They were big enough to deserve the bigger word. Why does it seem strange (p. 335) to speak of Huxley shedding light "*in* the province of paleontology," for the phrase is good and is exactly what is meant; or why does one smile when the author refers (p. 190) to Johannes Müller as "one of the lights of the world."

A few errors which escaped the proof reader will doubtless be corrected in another edition. The index is so incomplete as to lessen the usefulness of the book. Many important subjects and men treated in the text are not mentioned in the index. Such a historical account does not soon become out of date. It will surely have a number of editions and its minor defects can readily be removed.

Professor Locy has done good service in bringing together into one volume information as to the development of all the broader phases of biology and in presenting a general view which is, on the whole, so sound and well balanced.

MAYNARD M. METCALF

OBERLIN, O.,
January 29, 1909

The Young of the Crayfishes Astacus and Cambarus. By E. A. ANDREWS. Smithsonian Contributions to Knowledge. Vol. XXXV. Pp. 1–80, pls. I.–X. Washington. 1907.

The European crayfish has been upon the whole exceptionally fortunate in its biographers, for with it are associated the names of such excellent observers as Réaumur, Roesel von Rosenhof, Rathke, Huxley and Reichenbach, whose combined work, and more especially that of Huxley, have made it a classical type in the teaching of modern zoology. It is accordingly a little surprising that the American species, especially of *Cambarus,* which everywhere abound, should have escaped that careful analysis of their habits and development which their importance would seem to demand, until a series of papers extending to the monograph under review was begun by Professor Andrews five years ago.

The distribution and description of the many species, as well as the embryology and physiology of the common *Astacus fluviatilis* of Europe form the subject of a rather extensive literature, while the behavior and development of the young after leaving the egg, and the interesting family life first described by Roesel more than a hundred and fifty years ago, have hitherto received but scant attention. As the author suggests, this neglect may be attributed in some measure to the lack of a complete metamorphosis for which the crayfishes have been distinguished from the time of Rathke. Since their young are invariably hatched in a form which closely resembles the adult, greater interest has been taken in the life histories of marine crabs and shrimp, which, as a rule, hatch from

small eggs and must pass through a long and fascinating series of changes before the adult form and habit are attained. It should be added, however, that in the modern zoologist the lure of the sea is strong, even when crayfish abound in his back-yard and burrow all over his lawn. Roesel indeed complained of the neglect which obscured the life of common things in his day, and recalled the old Latin proverb to the effect that what is daily seen is little heeded.

In the present monograph, as well as in his earlier papers, Professor Andrews has thrown a light on many obscure questions, and has probably added more to our knowledge of the crayfish family life and general natural history than all previous observers combined.

For the first time the habits and development of an American species of *Astacus*, from the Pacific coast, are described, while its young have been reared to a length of two inches and an age of five months, when they have molted twelve times, and reached essentially the adult state. The behavior of these young is subjected to a careful analysis, and the text is illustrated by a series of excellent pen drawings showing in detail the slight but important changes which ensue in the body proper and its nineteen pairs of appendages during the first three stages, or until the young have become independent of their mother. Careful drawings to a uniform scale have seldom or never been made to represent the complete metamorphosis of any crustacean, and students of this important class will appreciate their value in the present case.

The habits and development of *Cambarus affinis* are treated in a similar descriptive and pictorial way, and the author devotes a chapter at the end to the weighing of the differences and agreements found in the two genera, and to certain speculations upon the possible origin of their diverse dependent stages and family life.

Astacus leniusculus lays its eggs, to the number of five hundred in the cases observed, in autumn, probably in October, and carries them attached to its pleopods all winter; these eggs are dark in color, and very large for a crustacean, having a diameter of two and one half millimeters, which accords with the precocious character of the young at birth. Hatching took place in late April and early May, and extended over several days. The young leave the egg in a relatively advanced but quite helpless condition, and if expelled from the mother, as in the case of the marine lobster, they would perish from lack of parental care, for they present a curious compound of embryonic, larval and adult characters. It is at this juncture that the peculiar family life of the crayfish has been developed to tide the young over a helpless period of infancy to complete independence, and the account of this interrelation of parent and child, and the correlated structures and instincts upon which it is based constitute the most interesting part of Professor Andrews's work.

The family relation in this *Astacus* endures for over a fortnight or until the little crayfish has molted for the second time, and is dependent upon a complicated chain of events, which suggests the story of the old woman who went to market to buy a pig. If the egg-stalk does not adhere to a "hair" of the parental swimmeret or to another egg; if the two egg-shells are not themselves adherent; if a certain delicate thread, which is spun as it were from an embryonic molt shed at hatching time, does not itself stick on the one hand to the telson of the young, and on the other to the inside of the inner egg-shell and thus tether the little one to its mother; if, again, a little later, when its leading string has broken, this young one has not been enterprising enough to seize and "hook on" to some part of the egg-glue with its great forceps, the tips of which have been bent into fish-hook form—it comes to certain grief. The result is fatal, at whatever point the chain weakens and snaps.

A few hours after hatching the helpless little crayfishes, still dangling from the "telson-threads," which secure each to the parent, begin to flap their abdomens, and to open and close their big hooked claws. In this way they manage to seize the old stalk of

the egg, and with hooks embedded in its tough chitinous "glue" they hold on literally "for dear life," often grasping the same stalk with both chelæ. So strong was this seizing and holding instinct that the young when forcibly separated from the mother would sometimes lay hold of a suspended string, and were thus successfully reared until the period of dependence was over. Once fixation with the claws is successful, the telson-thread breaks and the young remain thus attached by the claws alone for a period of from four to thirteen days, according to condition, when they molt to the second stage.

At the second molt this crayfish is for the first time free, and soon begins to descend the parental pleopod, climbs over its mother's body, and makes short excursions in the neighborhood, returning again and again to the alma mater and the family brood. Hitherto it has been sustained solely by the generous supply of yolk inherited from its egg-state, but since the egg-stalks and cases, as well as the cast skins which remain attached to the mother, disappear at this time, it is thought that they are eaten by the young and constitute the first direct food that they receive before beginning to forage for themselves.

The second stage *Astacus* develops a strong climbing instinct; it is brilliantly arrayed in red and blue pigments as well as the colors which the transparent skin transmits from liver and yolk. The swimmerets are functional, and the appendages generally are garnished with numerous sensory setæ; but the powerful "propeller" or tail-fan is not completed by the liberation of the sixth and largest pair of pleopods until the third stage is reached. Then the little crayfish becomes very active, voracious and pugnacious, frequently losing its limbs at the "breaking joints" and as freely regenerating them. At the fourth stage the rudimentary first pair of pleopods make their appearance, and probably in the males only.

The *Cambarus affinis,* which Professor Andrews has studied with marked success, lays its eggs in March or April, and carries them about seven weeks. Its eggs are smaller and rather more numerous than in the *Astacus,* and the young are correspondingly less advanced at the time of hatching. They do not leave their mother until the third stage, but are associated with her for about two weeks only, or for nearly the same length of time as in *Astacus.* In this case also at hatching the young are tethered, and prevented from escaping from the mother, but by an "anal thread" of a peculiar character. When this young escapes from the egg it leaves behind it a larval cuticle or molt, which sticks at two points only, on the side of the mother to the egg-membranes which are adherent to her, and on that of the child to a portion of the intestine where its cuticular lining is not at first set free. As a result of the tension this embryonic molt is stretched and crumpled with a tendency to turn the abdominal part inside out. This telescoping and partial inversion of the discarded cuticle is checked by the flat molted plate of the telson with the resultant production of a narrow creased ribbon, the "anal thread," which is firmly fastened to the intestinal wall.

The young of this crayfish attain a length of two inches during the first summer, when they may be fertilized by a male of corresponding age and lay fertile eggs in the following spring. In one case a female which was reared from the egg laid eggs herself in two successive seasons, when about one and two years old, and when somewhat more than two and three inches long respectively. Andrews remarks that since the young of this *Cambarus* reared in captivity not only laid fertile eggs, but since this was repeated in the next or third generation there would seem to be no obstacle to the domestication of this crustacean and rearing of it upon an extensive scale.

The first two stages of the young are thus not only peculiarly modified for association with the parent, but in some way unknown, correlated structures of a most delicate kind, not to speak of instincts, have arisen in both to bring this about. These may be compared to the first three stages of the lobster, in

which the young is not only a true larva, but pelagic. The lobster also makes good use, but in a different way, of a "lost larval molt," which is shed at the time of hatching. In this case also the molt sticks to the mother, that is, to the inside of the inner egg-membrane or chorion, and by being slightly adherent to the setæ or swimming hairs of the larva, helps to pull them out or evaginate them, and thus bring them into position for immediate use. To escape merely from its egg-shells, without losing in the proper manner this inner cuticular molt, is as fatal to the lobster as the premature breaking of the telson or anal threads would be to the crayfish.

The third stage in the crayfish corresponds approximately to the fourth stage in the lobster, in which the animal passes as if by a sudden leap into the adult-like form, but the transition is less abrupt in crayfishes since their most striking larval characters have been lost.

In giving up the free-swimming habits of their marine lobster-like ancestors, the crayfishes have apparently acquired their peculiar family life, and a "crawling instinct" would seem more in accord with the needs of many of the species which inhabit fresh watercourses liable to go dry, or which even burrow deep in the ground to find the necessary moisture.

The larval history of *Astacus* is thought to be "more primitive in having a more complete representation of a lost larval stage still evident in a complete cast cuticle within the egg." But this cuticle is apparently not homologous with that cast by the lobster at birth, the pre-pelagic stage of this form being represented by an egg-stage in *Astacus*. Again, since the family life is more completely developed in *Cambarus*, and the genus is more specialized than in *Astacus*, "we may therefore suppose," says Andrews, "that as *Cambarus* has migrated over the middle and eastern United States it has become split up into the sixty odd species now found and in some, as in *Cambarus affinis*, has made more perfect the association of young and parent already present in the *Astacus* ancestor."

It is further suggested that the apparent relation between acquisition of family life and migration from the sea to fresh water may be illusory, since metamorphosis has already been reduced in the marine lobsters, and since in bays and estuaries which must have been first encountered this dependent relation would seem to be especially valuable.

While it is easy to speculate on the origin of the specific characters of crayfishes, and we might add of any animals whatsoever, he concludes that "the nature and the amount of differences of the hard parts and in the larval history that distinguish one kind of crayfish from another are such as to raise the question whether utility and natural selection have played any part in their formation or in their perfection. All the specific and generic characters of crayfish may be as useless as color differences, and they may have arisen suddenly perfected as we see them, or they may have progressed in certain lines for long periods of time independent of external agencies." Much more evidence is needed before we can conclude that the various parts and functions displayed "have ever in any manner been connected with utility to the species or with the survival or extinction of individuals. Until the contrary is proven we may therefore regard them as the unmeaning by-products of unknown activities in the living protoplasm."

Such criticisms as are suggested in the reading of this careful paper are of a minor character. It does not seem proper to describe the invaginate matrix cells of the epidermis which secrete the cuticular sheaths of spines or setæ as "glands," since all the superficial cells of the epidermis are chitinogenous. Further, it would appear to be less confusing to limit the use of the troublesome term "larva" to the first two stages of the young, and to designate as "adolescent" or "adult-like" those stages in which the adult characters appear most pronounced, unless we resort to some such cumbersome terminology as that proposed by Hyatt.[1] It is certainly objectionable to designate as "larvæ"

[1] Science, N. S., Vol. V., p. 167.

(p. 39) the older young, which have attained a length of over an inch and may be several weeks, or even months, old.

It might appear hypercritical to raise the question whether the walking legs of a higher crustacean like the crayfish have claws (p. 23). Huxley got around this difficulty by using the terms "double" and "single claws" for the forceps of the first three and the "nails" of the last two pairs of legs, respectively, which describe the conditions met with in the crayfish exactly. This, however, does not correct the inappropriate though technical use of the Latin word *chela* for the pincers alone.

It is certain that metamorphosis in the higher crustacea has been reduced or eliminated under very different conditions in the rather numerous cases in which a reduction has occurred, as seen not only in the common lobsters (*Homarus*), but in many deep sea shrimps, shallow water *Alphei* and terrestrial crabs (*Gegarcinus*). As regards the possible influence which conditions of life in fresh water may entail, it is interesting to note that metamorphosis has been practically eliminated, not only in the fluviatile crayfish, but also in *Palæmonetes varians* of Europe and in *P. exilipes,* of parts of the eastern United States, one of the few fresh-water genera of prawns known, and that in this case their immediate marine ancestor, the common little *Palæmonetes vulgaris,* has a metamorphosis both long and complete.

FRANCIS H. HERRICK

Astronomy of To-day. By CECIL G. DOLMAGE, F.R.A.S. Pp. xvi + 363, with 45 illustrations and diagrams. Philadelphia, J. B. Lippincott. 1909.

The fascination of astronomy seems as strong to-day as in the distant past, when some knowledge of the heavens was essential to the every-day life of the traveler and the householder. To-day the compass, not the pole-star, guides the voyager across the seas and deserts; the watch and the calendar have replaced as timepieces the sun and the constellations, yet the interest in matters astronomical never wanes. To a large extent this interest is due to the ever-widening fields of astronomical research. Fifty years ago astronomy was practically confined to a mathematical explanation of planetary motion, with a few dry statistical facts concerning the size, shape and mass of the various bodies. To-day astronomy deals with the bodies themselves, with their physical conditions, their life histories, and the probable stages of their evolution. Physics and chemistry are the tools with which an astronomer of to-day works, photography and the photographic plate have replaced the eye and the hand in picturing the wonders of the heavens. Now this new astronomy appeals more directly to the popular reader than did the mathematical astronomy of the past century: one is more interested in knowing what a body is and how it came into being, than in learning the minute details of the path it is describing. That such is the case and that the interest in things astronomical is general, is evidenced by the increasing number of popular and non-technical books on various astronomical subjects.

The field of astronomy to-day, however, is so broad, it covers so much ground, that it can hardly be adequately treated of in a single small volume. The space in even a large book hardly suffices to give proper account of a single minor division of the great science. A single volume, which attempts to cover the entire field, can be but little more than a general index, pointing out to the reader the divisions of the subject, the relative importance of each, sketching in a broad way the principal facts and the underlying theories of celestial development, and indicating who the real workers are and where special details and facts can be obtained.

Now in some of these particulars the well got up and attractive book of Mr. Dolmage falls short of what such a book might be. If we regard the amount of space devoted to a subject as indicating to a certain extent the importance of the subject, then this volume shows some rather remarkable conceptions. For us the sun is undoubtedly the most important body in the heavens, it is the center

from which is derived the heat, the energy, the life of the earth. The countless myriads of stars and the numerous planets could be blotted out of existence without sensibly affecting our daily life; but if the sun ceased to shine the days of the world would be numbered. Again, the sun is a typical star and only by a minute and careful study of the solar constitution can we ever hope to derive some knowledge of the condition of the stars and the course of stellar evolution. Yet Mr. Dolmage devotes but eighteen pages to the study of the sun, and gives twenty-five to the moon and forty-four to eclipses. Comets, the ephemeral by-products of the solar system, are given just as much prominence as the sun itself. Again, the lines along which modern research is progressing are not clearly set forth, and the reader is often left in doubt as to who are the real workers and leaders in astronomical thought. Too much prominence is given to the opinions of writers of scientific fiction; it is certainly an innovation in a serious work to find H. G. Wells so freely quoted.

The book is well written and well printed, and it may serve the purpose described by its subtitle as "a popular introduction in non-technical language." The illustrations are well selected and many of the photographs are beautifully reproduced. The three views of the moon, taken from photographs made in the Paris Observatory, are exceptionally well rendered in the plates.

Charles Lane Poor

The Royal Society Archives: Some Account of the Letters and Papers of the Period 1741–1806, with an Index of Authors. Compiled by A. H. Church, D.Sc., F.R.S. Pp. 73. Oxford, 1908.

A valuable aid to the student who may wish to consult the original communications made between 1741 and 1806 to the Royal Society of London has been prepared by Dr. A. H. Church, to whom we are already indebted for a manuscript calendar of the collection of guard-books designated "Classified Papers." An earlier collection of letters addressed to the society or its officers, and comprised in forty-eight volumes, was indexed by W. E. Shuckard in 1840. The third set of guard-books, which comprises both letters and papers, consists of 127 volumes and these have been grouped in twelve decades, the letters and papers in each of these being numbered consecutively. The series is designated "Letters and Papers." Although most of the material of the letters was published in the *Philosophical Transactions* of the society, they were edited to a considerable extent, and much of the personal note was removed in this way. From among many interesting items noted by Dr. Church in his pamphlet, we select the following:

Decade I., No. 403. In a letter dated May 4, 1745, R. A. F. de Réaumur says:

> I heartily wish there was in the world as strong a moral attractive power as there is a natural one that might dispose our two nations particularly to seek to unite by mutual acts of friendship and good will.

Decade II., No. 198. An unpublished letter of Benjamin Franklin, dated February 4, 1750, describes certain experiments in killing hens and turkeys by the electric current. Franklin proceeds to relate his personal experience of an electric shock from the apparatus employed:

> In making these Experiments, I found that a man can without great Detriment bear a much greater Electrical Shock than I imagin'd. For I inadvertently took the Stroke of two of those Jars thro' my Arms and Body, when they were very near full charg'd. It seem'd an universal Blow from head to foot throughout the Body, and was followed by a violent quick Trembling in the Trunk, which went gradually off in a few seconds. . . . My Arms and Back of my Neck felt somewhat numb the remainder of the Evening, and my Breastbone was sore for a Week after, as if it had been bruised.

Decade II., No. 494. A letter in Latin from Linnæus, acknowledging his election to the society. A facsimile of this letter is given in Dr. Church's pamphlet.

Decade III., No. 117. A letter, also in Latin, from Josef Stepling, concerning a shower of meteoric stones that fell near Strkow in Bohemia, July 3, 1753. One of these aerolites is now in the British Museum.

Decade IV., No. 84. A letter from the Rev. Wm. Hirst dated Fort St. George, E. Indies, February 25, 1761, offers a careful drawing of a leaf-insect with the remark:

Nature seems to have provided for its security by giving it so strong a resemblance to Blades of Grass among which it is frequently found.

Decade V., No. 60. In a letter dated St. Petersburg, 21 Oct./1 Nov., 1768, in which Leonard Euler alludes to his blindness, occur these words:

As the British Parliament were pleased to reward so generously the slight researches which I had made on the Lunar Theory.

Decade V., No. 80. A letter, dated Rio de Janeiro, November 30, 1768, from Captain James Cook to Dr. Morton, secretary of the Royal Society, wherein Cook writes:

The account we gave of our Selves of being bound to the Southward to observe the Transit of Venus (a Phenomena they had not the Idea of) appeared so strange to these narrow-minded Portuguese that they thought it only an invented Story to cover some other design we must be upon.

Decade VI., No. 40. On March 24, 1774, a paper was read by Edward Spry, a well-known surgeon of the day, explaining his antiseptic treatment of amputations by the use of a special dressing, "preventing putrescence."

Decade VI., No. 119. Professor John Winthrop, of Cambridge, Mass., described, in a letter dated November 16, 1774, a pictorial hieroglyph inscribed on a rock twenty miles south of Boston, on the Taunton River.

Decade VIII., No. 1. Writing to Sir Joseph Banks, Sir William Herschel names a new star, Georgium Sidus.

Decade IX., No. 27. A paper of 19 pages communicated by Pierre Laporterie under date of August 14, 1786, and entitled "Saphir crystal, susceptible de l'étoile a six raions"; not printed.

Decade X., No. 65. Paper by Sir William Herschel on the "Quintuple Belt of Saturn"; read December 19, 1793; not printed.

Decade X., No. 70. Letter of Alessandro Volta regarding Galvani's discoveries; read in January, 1794; not printed.

Decade XI., No. 93. An account of the Andaman Islands and their inhabitants, by Captain Archibald Blair. 82 pages and map; read April 4, 1799.

Decade XII., No. 28. Description of what he calls a pulmonary calculus, by Philip Crampton. This concretion was seven inches in diameter and weighed 845 grains.

In addition to the names mentioned above, the following are especially noteworthy: John Abernethy, Abbé Jean Jacques Barthélemy, G. B. Beccaria, Comte de Buffon, Charles Burney Mus. Doc., Hon. Henry Cavendish, Duc de Chaulnes, Richard Chenevix, Erasmus Darwin, Sir Humphry Davy, Sir William Hamilton, Rev. John Lightfoot, Jean Hyacinthe de Megalhaens, P. L. M. de Maupertius, Rev. Joseph Priestly. The index contains more than fifteen hundred names, and enables the student to refer without delay to each paper or letter in the collection.

GEORGE F. KUNZ

SPECIAL ARTICLES

A REVISED CLASSIFICATION OF THE NORTH AMERICAN LOWER PALEOZOIC[1]

CLASSIFICATIONS of stratigraphic subdivisions are bound to change with the expansion of our knowledge of detail, so that the most recently accepted must still be regarded as a tentative one, to be replaced by a better one when needed, and the knowledge of facts warrants it. The generally accepted classification of the Lower Paleozoic of North America, proposed by Clarke and Schuchert in 1899, is now in part out of harmony with known facts, while recent interpretation of previously known facts still further suggests the desirability of modification. For *the Cambric system* Clarke and Schuchert retained essentially the classification of Walcott, which, so far as it is applicable to the facts, is a perfectly satisfactory one. The Lower Cambric or Georgian, however, is typically developed only in the Appalachian and western provinces together with the corresponding regions of northeastern and southern Asia. The Atlantic province both of America and Europe

[1] Abstract of a paper read before the joint meeting of the New York Academy of Sciences and eastern geologists, April 6, 1908.

is known to be distinct, and the Holmia fauna of this province has few, if any, types in common with the Olenellus fauna of what might be called on the whole the Pacific province and its various intracontinental extensions. For that reason it would be well to restrict the term Georgian, and its paleontological equivalent, *Olenellus fauna,* to the Pacific province, and to adopt Matthew's term, Etcheminian (including Coldbrookian) for the Lower Cambric of the Atlantic province of America and Europe. For the corresponding fauna the term *Holmia fauna* should be adopted, since the term Olenellus fauna, now generally applied to this *fauna without true Olenellus,* is not only incongruous, but inevitably misleading; for it implies physiographic conditions which are now known not to have existed.[3] The Middle Cambric best known is that of the Atlantic province with its Paradoxides fauna. For this, the recognized term Acadian is most appropriate. This name, used by Matthew for the lower division of his St. John group, is thus extended to include the lower half of the Johannian, or middle division of that group. It might be desirable to use a distinct name for the Middle Cambric of the Pacific (inclusive of Appalachian) province, since these provinces were perhaps even more distinct than in Lower Cambric time. The Upper Cambric was for a long time called Potsdamian. Recognizing the unsuitableness (except in a historic sense) of this name, Walcott has proposed Saratogan to replace it. Though much better than the old name, this is still extremely unsatisfactory, because at Saratoga only the upper and in many respects least characteristic portion of the series is known. It is doubtful if the Saratoga section represents more than the Tremadoc division of the European Cambro-Ordovicic transition; and aside from *Dicellocephalus,* its trilobite fauna scarcely represents the Upper Cambric.

[3] It should be noted that the North Scottish occurrence of the Olenellus fauna is clearly distinct from the Atlantic province, as repeatedly pointed out by Geikie. It probably belongs to an Arctic extension of the Pacific province.

On the Atlantic coast, the upper Johannian and the greater part of the Bretonian of Matthew's St. John group represents a typical Upper Cambric series in close harmony with that of Europe, with which it shows a striking paleontologic correspondence. The best development is on the island of Cape Breton, where its thickness approaches a thousand feet, if it does not exceed that, and where it includes the characteristic faunal zones of Europe. The upper part of the Bretonian of Matthew includes basal Ordovicic beds, the line between this and the Cambric being generally drawn at the summit of the zone with *Asaphellus homfrayi,* the equivalent of the Tremadoc. This section forms a better standard for the Upper Cambric than any other known in America, and the name *Bretonian* would be most appropriate for it. Its meaning would have to be extended so as to include the upper part of the Johannian of Matthew, which term would then be discarded, while the beds above the Tremadoc horizon should be separated from it. This readjustment would not be very different from that which makes Acadian in its wider sense include the lower half of the Johannian, in addition to the Acadian in its narrower lithologic sense. Since the provinces of the Upper Cambric were less distinct, one name would suffice, but that should be Bretonian or some other equally appropriate name, rather than Saratogan or Potsdamian.

The *Ordovicic system* has undergone a variety of classifications. At present the one generally accepted includes the Beekmantown and Chazy in the Lower, as Canadian; the Black River and Trenton in the Middle, as Mohawkian; and the remainder as Cincinnatian or Upper Ordovicic. This classification is out of harmony with stratigraphic and paleontologic facts. Stratigraphically, the Canadian represents some five thousand feet of calcareous strata (where developed to a maximum), while the Mohawkian includes scarcely six hundred feet. The Cincinnatian as now understood is also less than a thousand feet thick, and is in part a phase of the Upper Mohawkian. The Canadian includes two distinct faunas, while the faunas

of the Mohawkian and Cincinnatian are essentially a unit.

In the Mohawk Valley less than five hundred feet of Beekmantown occur, but in the southern Appalachians, from central Pennsylvania south, its thickness is 2,500 feet or more. This, as has been shown by myself[3] and worked out in detail by Berkey,[4] represents a regressional movement of the sea, begun in Lower Beekmantown time and continued throughout; so that the full measure of the depositional series is found only in the non-emerged areas of the Appalachian trough. Northward and westward from this the higher beds fail progressively, the series in central United States being complicated by the desert sands now constituting the St. Peter sandstone. Though it began before the Upper Cambric transgressional movement was fully spent, the greater part of Beekmantown sedimentation was accomplished during a period of emergence of the North American continent.

The Chazy, represented only by its higher beds, the Lowville, in the Mohawk Valley, is nearly 2,500 feet thick in central Pennsylvania, and has a similar thickness in the Appalachians southward. From the region of its greatest thickness, which is also the region of maximum development of the Beekmantown, the Chazy thins northward and westward by failure of its lower members and progressive overlap of its higher. Except in the region of non-emergence, *i. e.*, the Appalachian trough from central Pennsylvania southward, it rests disconformably upon the Beekmantown, the hiatus between the two constantly increasing northward and westward. When present, the St. Peter sandstone marks the plane of this disconformity, though its thickness is no measure of the magnitude of the hiatus. The Chazy thus represents a transgressional series, pronounced in its occurrence over most of North America, but of limited extent in the type region in the St. Lawrence embayment.

The Black River and Trenton limestones mark the continuance of the transgressive movement. The maximum thickness of the Trenton is less than a thousand feet, and in most places in the east it is partly replaced by the Utica shales. Thus in western New York the limestone referred toTrenton is over 950 feet thick, and the succeeding shales are probably Lorraine with little Utica. Eastward the Utica or black shale phase begins earlier, the higher limestones being replaced by the lower shales. Thus in the type region near Utica the limestone is in the neighborhood of 300 feet thick, and the Utica shale is 700 feet. Still further east, near Amsterdam, the limestone has become reduced to 37 feet, while the shale has increased to over a thousand feet. Northward the limestone increases again to nearly 600 feet in the Montreal region, while the thickness of the shale diminishes. In central Pennsylvania about 700 feet of limestone and 600 feet of shale occur, but in southern Pennsylvania Stose has found that the Trenton is almost entirely replaced by the Utica phase of shale, of which there are almost 1,000 feet of strata. These shales are succeeded by the Eden formation, which in the Cincinnati region rests on Trenton limestone. It thus appears that Trenton limestone and Utica shale represent different lithic and corresponding faunal phases of the same period of sedimentation.

During the succeeding Lower Cincinnati period an extensive retreatal, followed by a readvance movement of the interior North American sea, occurred. As a result, in the marginal portions of this sea, as in the Rocky Mountains, late Richmond rests on early Trenton or earlier beds. In the Appalachian region, extensive continental deposits marked the closing stages of this period, while in the Taconic and Acadian regions, folding was in progress.

As already intimated, three faunas are found in the American Ordovicic: (1) that of the Beekmantown; (2) that of the Chazy; (3) that of the remainder of the series. The Black River fauna is in a measure transi-

[3] SCIENCE, N. S., Vol. XXII., pp. 528–535, October 27, 1905, and *Bull. Geol. Soc. Am.*, Vol. 17, p. 616, 1906.

[4] *Bull. Geol. Soc. Am.*, Vol. 17, pp. 229–250, 1906.

tional, and may be classed with either Trenton or Chazy. These faunas and their distinctness in their calcareous as well as graptolitic phases, are well known. The last of these faunas, the Trenton-Cincinnati fauna, is of almost worldwide distribution, characterizing the foreign Upper Ordovicic.

For purposes of intercontinental correlation, the graptolites are most satisfactorily employed. The world over, *Tetragraptus* and *Phyllograptus* characterize the lowest Ordovicic, while *Didymograptus bifidus* further represents the highest part of this lower division. In England, the Arenig rocks include these graptolite zones, and on the continent of Europe and in Australia, etc., this Arenigian division or lower Ordovicic is marked by the same graptolites. In America the shales carrying these graptolites are now regarded as of Beekmantown age, and the correlation of Beekmantown with Arenig is generally accepted. Frech, indeed, draws the line somewhat lower, making the Beekmantown (Calciferous) the equivalent of the Tremadoc and part of the Arenig only. Frech, however, draws the dividing line between the Beekmantown and Chazy below the Fort Cassin beds, so that a part of his Chazy is really Beekmantown in the accepted sense. From this it appears that Lower Ordovicic in America should include the Beekmantown only, applying this term to the formation in its maximum development of 2,500 feet. The term *Beekmantownian* would, therefore, be suitable as an American equivalent of Arenigian or Lower Ordovicic. The Little Falls dolomytes of the Mohawk Valley represent only the lower part of this series, a similar horizon being probably represented by Cushing's "Potsdam" and Theresa formations of northwestern New York. Such a classification would end the Lower Ordovicic with the termination of the great retreatal movement of the sea, which, as shown elsewhere, resulted in the almost complete emergence of the North American continent. The Middle Ordovicic of North America would thus begin with, and be characterized throughout by, an equally great transgressive movement, which, with minor oscillations, again submerged the continent nearly to the extent it had suffered before the emergence.

That the Chazy, with a maximum thickness of 2,500 feet, makes an adequate representation of the Middle Ordovicic can hardly be questioned. Its fauna is distinct, though not without its relationships to both preceding and succeeding faunas. In fact, the Upper Stones River phase of the fauna is so closely related to the Black River fauna that the horizon of the latter is regarded by some as more probably belonging to the Chazy. The Stones River and Lowville faunas seem to be facies faunas of the Chazy, rather than definite indices of the subdivisions of this fauna. Thus while in general the Stones River seems to be a late phase of the Chazy, succeeding the Champlain phase of the Chazy, throughout the interior, the order seems to be reversed in the South Mountain area of Pennsylvania and adjoining districts, where Stose found the Upper Shenandoah to contain a Stones River fauna *followed* by a Chazy-Black River fauna (Chambersburg limestone). Unless there is an error here, the Stones River fauna and typical Chazy fauna (*i. e.*, that of the St. Lawrence embayment) must be considered as contemporaneous. From what has already been said of the relationships of Trenton and Utica deposition, the former must be classed with the Upper Ordovicic. This is further shown by the faunal unity of these formations, many of the most characteristic brachiopods, bryozoa, mollusks and trilobites making their first appearance in the Trenton and continuing through the Cincinnati beds. These types, as already noted, are of wide distribution and are characteristic only of the Upper Ordovicic or Caradocian of Europe and elsewhere, and more especially of the higher zones of this division.

The dividing line between Middle and Upper Ordovicic is drawn in Europe above the zone of *Cœnograptus gracilis*. This graptolite characterizes the Normanskill zone of America, which lies below the Trenton limestone in the Hudson Valley and probably represents Black River horizon if not late Chazy. Ac-

cepting the former equivalency, the dividing line between Middle and Upper Ordovicic should be drawn at the summit of the Black River. This is where Frech draws it, throwing the Trenton limestone into the Upper Ordovicic. In this I believe he is correct, though I am not fully prepared to class the Black River with the lower horizon. Dana's tentative correlation of American and British Ordovicic strata parallels Arenig and Beekmantown, Llandeilo and Chazy, Bala-Caradoc and Trenton, and the lower Llandovery and Utica-Hudson. The lower Llandovery is now referred to the base of the Siluric; the "Hudson" (Lorraine-Richmond) together with the Utica-Trenton thus being referable to the Caradocian.

For the American Middle Ordovicic the term *Chazyan* is here proposed. The old term Canadian would as a result become of no further significance. For the Upper Ordovicic the term *Trentonian* may serve, since Trenton deposition covers at least one half this division. Moreover, the name Trenton Period was used by Dana for Trenton limestone and later divisions. *Nashvillean* would perhaps be a better name, if it is a fact that the Nashville group of Safford covers both Trenton and later Ordovicic formations. *Cincinnatian* is definitely in use for Eden to Richmond inclusive, and though its meaning might be extended to include Trenton limestone, the fact that it is in general use for the higher beds might lead to confusion. The term Mohawkian would, of course, fall into disuse.

In the Appalachian region, extensive fans of continental deposits were formed during late Ordovicic and early Siluric time.[5] In southern Pennsylvania these comprise the basal white beds, generally referred to in the literature as "Oneida," and for which the name *Tyrone* is proposed, from a locality in Pennsylvania where they are typically shown; the middle red beds or Juniata, often called red Medina; and the upper white or Tuscarora, commonly called white Medina. (The Green Pond conglomerates and Longwood shales, and their equivalents in the Delaware and Schuylkill gaps, are not referred to here. They belong in the Salina or Middle Siluric division.) In western New York, the Juniata is represented by the Queenston shales of the present author (red Medina shales of most authors), and the Tuscarora in part by Medina. The Siluro-Ordovicic dividing line falls approximately between these two, *i. e.*, between the Juniata and Tuscarora, or the Bays and Clinch, their southern equivalents. Fossils in the Juniata and Bays (included where the river-laid beds dipped into the sea) indicate their late Ordovicic (Upper Lorraine) age.

The *Siluric* has been discussed in a previous communication (January 6, 1908, SCIENCE, N. S., Vol. XXVII., pp. 622–23, April 17, 1908), and will be more fully treated in the forthcoming article already referred to. The essential points to be noted are: (1) That the Oswegan of Clarke and Schuchert is now known to be in part Ordovicic and in part Salinan. (2) That the Siluric begins with the Medina sandstone (exclusive of Queenston shales) of western New York, which has a thickness of about 100 feet (Upper Medina of authors generally) and contains a fairly abundant fauna of Siluric age, most nearly related to the Clinton. (3) That the Clinton of the type section in eastern New York includes apparently part of the higher Niagaran beds of western New York. (4) That the pre-"Clinton" Siluric beds of the interior (Cape Girardeau beds; Alexandrian beds of T. E. Savage) are to be classed with the Lower Siluric, for which the term *Niagaran,* used by Dana for all these, is to be restored. (5) That the Middle Siluric is represented only in the interior of North America by the non-marine Salina, including the Green Pond-Shawangunk and Longwood beds. (6) That the Monroe formation or *Monroan* of Michigan, Ohio and Canada constitutes the true Upper Siluric, the Cayugan of New York (exclusive of the Salina) representing only the uppermost portion of the Monroe series.

Expressed in tabular form, the classifications here proposed are as follows:

[5] These will be fully discussed in a forthcoming paper by the author.

Siluric or Ontaric.	Upper Siluric or *Monroan* (900–1,000 ft.)	Upper Monroe (including Manlius, Rondout, Cobleskill and Bertie of New York). Middle Monroe (Sylvania sandstone, only known representative). Partly marked by pronounced hiatus. Lower Monroe (including water limes of Ohio, marine "Salina" of Maryland).
	Middle Siluric or *Salinan* (1,000 ft.)	Represented by the non-marine Salina sediments only in North America so far as known (including Green Pond and Shawangunk conglomerates and the red Longwood shales).
	Lower Siluric or *Niagaran* (1,000 ft.)	Guelph. Lockport. Rochester. Clinton. (Limestones and shales of western New York; Medina sandstone, including Oneida conglomerate, Tuscarora sandstone of Pennsylvania and Maryland and Clinch sandstone of Tennessee.) Cape Girardeau or Alexandrian (a possible equivalent of some of the Clinton divisions given above).
Ordovicic or Champlainic.	Upper Ordovicic or *Trentonian* (or Cincinnatian, *sens. lat.*, or Nashvillean) (1,000–1,500 ft.)	Richmond. Lorraine (including non-marine sediments; *i. e.*, Oswego and Queenston sandstones and shales of New York, etc., Tyrone and Juniata conglomerates and sandstones of Pennsylvania; Bays sandstone of Tennessee). Eden formation (probably in part represented by Tyrone conglomerate). Utica—Trenton series.
	Middle Ordovicic or *Chazyan* (2,500 ft.)	Black River (including Normanskill shales). Chazy limestone series of Lake Champlain region, and local facies, such as Lowville, Pamelia, Stones River, Chambersburg beds, etc.
	Lower Ordovicic or *Beekmantownian* (2,500 ft.)	Beekmantown limestones and dolomytes, of Lake Champlain, Deepkill and Levis shales; various local subdivisions, as Little Falls dolomyte and probably the so-called "Potsdam" and Theresa formation of northwest Adirondack region.
Cambric or Taconic.	Upper Cambric or *Bretonian*	Upper part of the St. John group of the Acadian provinces and New Foundland (including Potsdamian and Saratogan as upper members, equivalent approximately to Tremadoc).
	Middle Cambric or *Acadian*	Paradoxides and Protolenus beds of Atlantic province and equivalent beds of Pacific province and Appalachian embayment.
	Lower Cambric or *Etcheminian* ..... or *Georgian*	Etcheminian shales (including Coldbrookian) of Atlantic province (Holmia fauna). Georgia lutytes and arenytes, limestones and dolomytes of Pacific-Appalachian province (Olenellus fauna).

Amadeus W. Grabau

Columbia University,
October, 1908

RESEARCH WORK IN CHEMISTRY AT THE UNIVERSITY OF ILLINOIS

ON the evening of January 18 the Sigma Xi of the University of Illinois, held an open meeting in the chemical laboratory for the purpose of exhibiting the apparatus and methods used in research work in that department at the university.

In connection with the exhibit the following list of researches now in progress at the university was prepared. A part of these researches are conducted in the department of physiology, and a part in connection with the agricultural experiment station.

Physical Chemistry and Electrochemistry: DR. WASHBURN and DR. LACY.

E. W. Washburn: New determination of the electrochemical equivalent. Simple method for deriving thermodynamic equations.

D. A. MacInnes: Freezing point, electrical conductivity and viscosity of solutions of cæsium nitrate and lithium chloride.

O. C. Stanger: Heat of dilution of cane sugar solution.

Grinnell Jones: Negative coefficient of expansion of silver iodide.

G. McP. Smith: Reversible metallic displacements in aqueous solutions.

H. C. Bennett: Electrolytic preparation of alkali and alkali earth amalgams.

Inorganic Chemistry: DR. BALKE, DR. HOLMES, DR. SMITH, DR. ISHAM, DR. JONES.

C. W. Balke: Atomic weight of tantalum.

L. H. Almy: Double fluoride of columbium and tantalum.

J. T. Nuttall: Double fluorides containing thallium and aniline.

J. E. Egan: Rare earths.

G. McP. Smith: Substituted ammonium amalgams. Determination of the density of gases by diffusion.

Helen Isham: Ferrates.

Mabel Gridley: Compounds containing hydroxylamine of crystallization.

W. B. Holmes, W. E. Knapp: Boiler water reactions.

C. E. Millar: Determination of cadmium.

V. R. Ross: Action of hydrochloric acid on manganese dioxide.

W. G. Eckhardt: Use of hydrofluoric acid in soil analysis.

Organic Chemistry: PROFESSOR CURTISS, PROFESSOR NOYES.

R. S. Curtiss: Derivatives of malonic acid and 1.3 diketones.

J. A. Kostalek: Nitrogenous acid derivatives of ethyl malonate.

F. Grace Spencer: Tartronic ester derivatives.

E. K. Strachan: Action of haloid acids on ethyl oxomalonate.

H. S. Hill: Alcohol condensations with ethyl oxomalonate.

J. J. Miller: Action of nitrous anhydride on 1.3 —diketones.

G. T. Davis: Acyl peroxides.

W. A. Noyes: Molecular rearrangements in the camphor series.

C. G. Derick: Laurolene.

E. E. Gorsline: Camphononic acid.

Luther Knight: Isocamphoric acid.

Laboratory of Physiological Chemistry: PROFESSOR GRINDLEY.

H. S. Grindley, J. W. MacNeal, F. W. Gill: Effect of saltpeter in meat on metabolism.

H. S. Grindley, A. D. Emmett: Influence of different quantities of feeding stuffs on the metabolism of steers.

F. W. Gill, S. G. Allison, S. R. Wreath: Determination of sulphur.

F. W. Gill, J. B. Peterson: Determination of phosphorus.

R. M. Kibbe, A. F. Wussow: Determination of urea.

F. W. Gill, H. W. Hachmeister: Occurrence and distribution of nitrates in foods, feces and urines.

Physiological Chemistry: PROFESSOR HAWK.

H. A. Mattill: Heat of combustion of the hair of different races.

H. A. Mattill: Methylphenylosazones of levulose and glucose.

C. C. Fowler: Influence of copious water drinking on gastric digestion.

P. E. Howe, H. A. Mattill: Variations in the morphological constituents of the blood and in the "nitrogen partition" of the urine of dogs as influenced by fasting.

DR. PETERS.

Opal Burres: The diastatic enzyme of *Paramœcium* in relation to the killing concentration of copper sulphate.

H. A. Mattill: The diastatic enzyme of ripening meat.

H. W. Stewart: The absorption and partial purification of catalase from liver.

Opal Burres: A chemical and physiological study of some enzymes and toxins from *B. pyocyaneus*.

O. C. Stanger: The action of light, of oxidizing and of reducing agents upon a purified catalase.

J. H. Brown: The nature and action of the glycolytic enzyme of autolyzing muscle.

R. D. Glasgow: The extraction and properties of lipase from insects.

Industrial Chemistry: Professor Parr, Dr. Mears.

Brainerd Mears: Gas calorimeter.

D. L. Weatherhead: Asphalts.

W. F. Wheeler: Weathering of coal.

J. M. Lindgren: Boiler water.

F. W. Bliss: Occluded gases in coal. Determination of water by the phase rule.

T. R. Ernest, W. S. Williams: Sand-lime brick, and artificial silicates.

E. C. Hull: Distillation of coal at low temperatures.

R. F. Hammer: Ammonia from nitrogenous waste.

W. F. Wheeler: Calorimetric studies.

F. W. Kressman: Spontaneous combustion of coal.

Water Survey: Professor Bartow.

Softening of the water supply of Champaign and Urbana. Clarification of cistern water. Character of water from shallow wells in cities. Municipal water supplies.

L. I. Birdsall: Action of coagulants on Lake Michigan water.

W. C. Marti: Boiler water treatment.

G. A. Van Brunt: Treatment of water with bleaching powder.

Agricultural Chemistry: Professor Hopkins.

L. H. Smith, C. H. Myers: Breeding of corn and other crops to improve the chemical composition.

J. E. Readhimer, W. G. Eckhardt, O. F. Fisher, E. Van Alstine, J. P. Aumer, J. B. Park, Gertrude Niederman: Investigation of factors of fertility for Illinois soils, including work on experiment fields in various parts of the state and also pot experiments.

Robert Stewart: Quantitative relationships of carbon, nitrogen and phosphorus in soils.

L. H. Smith, W. B. Gernert: Transmission of the characters in corn with respect to the chemical composition of the kernel.

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

The annual meeting of the Washington Academy of Sciences was held at the Cosmos Club, Washington, D. C., on Thursday, January 21, 1909.

President Walcott and about thirty members were present.

After receiving and approving the reports of the secretaries, treasurer and editor for the year just closed, the following officers were elected for the ensuing year:

President—C. D. Walcott.

Vice-presidents:

Anthropological Society—Walter Hough.
Archeological Society—Mitchell Carroll.
Biological Society—T. S. Palmer.
Botanical Society—J. N. Rose.
Chemical Society—H. W. Wiley.
Engineers Society—D. S. Carll.
Entomological Society—A. D. Hopkins.
Foresters Society—Gifford Pinchot.
Geographic Society—Willis L. Moore.
Geological Society—A. H. Brooks.
Historical Society—J. D. Morgan.
Medical Society—E. A. Balloch.
Philosophical Society—C. K. Wead.

Managers—1910: Geo. M. Kober, F. V. Coville, Bailey Willis. 1911: L. O. Howard, O. H. Tittmann, B. W. Evermann. 1912: L. A. Bauer, C. H. Merriam, C. F. Marvin.

At the close of the year the statistics of membership were as follows:

Patrons	7
Honorary members	1
Life members	1
Resident members	173
Non-resident members	157
Total	339

The non-resident members are geographically distributed as follows: California, 18; Canada, 4; Colorado, 1; Connecticut, 10; District of Columbia, 3; England, 1; Illinois, 7; Indiana, 5; Iowa, 2; Maryland, 8; Massachusetts, 24; Michigan, 1; Minnesota, 4; Missouri, 5; Nebraska, 1; New Hampshire, 3; New Jersey, 4; New York, 25; North Carolina, 1; Ohio, 4; Pennsylvania, 13; Philippines, 1; Rhode Island, 2; Tennessee, 1; Texas, 1; Virginia, 3; West Virginia, 1; Wisconsin, 4.

During the year 1908 the academy published Volume X. of its *Proceedings*, which contained 248 pages, 2 plates and 12 figures.

ON the evening of February 1 Professor Albrecht Penck, of Berlin, delivered before the Washington Academy of Sciences an illustrated lecture on "The Antiquity of Man." Professor Penck kindly furnished the following abstract:

"The antiquity of man dates far back beyond all historical record. It is a purely geological question which must be treated by means of geological observation. It has been known for quite a long time that in western Europe man existed during the glacial epoch. The French geologists and anthropologists, however, who maintained this, assumed only one glacial epoch, while we know to-day that the great ice age consisted of different glacial times separated from one another by interglacial times. The traces of the various glacial epochs consist of moraines of different geological and morphological age, and there is a very strong similarity between the Wisconsin, Illinoian and Kansan moraines of North America and the Würm-, Riss- and Mindel-moraines in the circumference of the Alps, and the Günz-moraines which can be compared with the pre-Kansan moraines of North America. The traces of the interglacial periods consist of deposits with a fauna or flora which is not reconcilable with glacial conditions. The glacial conditions are determined by a lowering of the snow-line of three to four thousand feet below the snow-line of to-day as can be shown by the evolution of old glaciers, while there are indications in the Alps, judging from the corresponding flora, that the snow-line of interglacial times lay about one thousand feet higher than to-day.

"The traces of paleolithic man are found generally outside of the morainic deposits of central Europe, but there are some places where we find those traces above the moraines even of the last glacial epoch, of the Würm or Wisconsin. These are the very well-known stations of Magdalénien near Schaffhausen in Switzerland, of the Schweizersbild and the Kessler Loch. Surely man existed here after the retreat of the ice, but the accompanying fauna is still a glacial one. Man existed here just after the maximum of the last glacial epoch. We have abundant evidence of the existence of man during the beginning of the last glacial epoch as indicated by many paleolithic implements found in the loess deposits, especially those of the valley of the Danube and the valley of the Rhine, which all belong to the Solutréen.

"Of the greatest importance is the occurrence of human relics in the cavern of the Wildkirchli on Mt. Säntis in Switzerland. Here Mr. Bächler discovered, at a height of nearly five thousand feet, together with the relics of one thousand cave bears, several hundred paleolithic instruments of Moustérien type. As we know that the Moustérien is older than the Solutréen and Magdalénien, and since it is quite impossible that man existed here during the glacial epoch, we have to deal here with traces of an interglacial man who had already appeared in the Alps, and this conclusion is corroborated by the fact that the cavern of the Wildkirchli exists in a region which overlooked the old glacier of the Rhine and the local glaciers of the Säntis, so that it was protected against glacial erosion. Probably during the last ice age the whole cavern was filled up with ice, so that the formation of the loam in the cavern ceased and no deposit was forming during the whole glaciation.

"The excavations made by order of the Prince of Monaco in the caverns near Mentone proved indeed that man existed there during the last interglacial epoch, for we find in the Grotto of the Prince beneath the cavern deposits of the glacial fauna, such deposits as an interglacial fauna contain: human skeletons and the implements of the Moustérien type. At other places, especially in France, the Moustérien implements are found together with a glacial fauna. All these localities lie outside of the Riss glaciation, and they are never met with in the realm of the old moraines, as for example, the Magdalénien. We, therefore, must believe that the Moustérien with the cold fauna is contemporaneous with the Riss ice age.

"Quite recently Mr. Hauser has discovered at Le Moustiers a human skeleton, the skull of which is of Neanderthal type, such as has been also found at Spy and Krapina. The recently discovered human jaw of Heidelberg described by Schoetensack belongs evidently to an older interglacial epoch, probably to that very long time between the Mindel and Riss ice ages, where we have also to place the Chelléen implements. Thus we have full evidence that man existed already before the Riss or Illinoian glaciation. Now it can be shown that the time elapsed since the last glaciation is far shorter than the time between the last and the glaciation before the last, between the Würm and Riss ice age. This interglacial time, however, is again far shorter than that long interval between the Mindel and Riss ice age. If, therefore, we have some reasons to believe that the time since the last glaciation was at least twenty thousand years, we must believe that the Heidelberg man dates back about two hundred thousand years.

"Far older are those eoliths found in Belgium and in southeast England. They belong to the early Pleistocene epoch. And indeed we must

expect to find here implements made by early man or his predecessor, but the question is if his predecessor already belongs to the genus *Homo* or to the anthropoid apes. When we discover that the recently extinct natives of Tasmania manufactured eoliths of the same kind as those found in the old Pleistocene gravels of Belgium and England, in the upper Miocene of central France and the upper Oligocene of Belgium, we feel inclined to believe that those implements may not be regarded as *human* artefacts but as having been made by a predecessor of man. Indeed those oldest eoliths occur in a group of anthropoid mammals the genera of which are totally extinct, and it would be very surprising to find that only the genus *Homo* remained unchanged while all other genera developed."

Dr. Merriam remarked upon the Moustérien skull, suggesting that it appeared to be the skull of a child; and called attention to the remarkable differences between the Heidelberg jaw and that of man to-day, a difference so great as to indicate that the Heidelberg jaw may not belong to the genus *Homo*.

Mr. Willis inquired for the evidence that the eoliths found in Tertiary formations were actually shaped by hand and Professor Penck responded by pointing out their peculiar form, one part being shaped as if to hold in the hand and the other part a sharp edge or series of points for cutting. Such eoliths have been found dulled, as if used by man or his ancestor.

Dr. Hough remarked that as man is the only animal that has ever used fire, he desired to know whether or not traces of fire had been found at the various European localities with the other evidences of man, and Dr. Penck replied that traces of fire were found constantly with other evidences as far back as the Moustérien skeleton. No trace of fire was found with the Chelléen implements because they are alluvial and none could be preserved in such deposits.

Dr. Frank Baker called attention to the controversy that had arisen regarding certain prehistoric remains, particularly the jaw of La Naulette. It had been held that the eminences for attachment of the muscles of the tongue upon that jaw were so slight as to indicate that the animal to which the jaw belonged resembled apes in lacking the faculty of speech. Judging from the figures of the Heidelberg jaw displayed on the screen, these eminences were particularly well marked in that specimen, which would argue a special use of the tongue either for speech or for some allied function.

Mr. Spillman referred to the teeth of the Moustérien skull as being like those of a child.

J. S. Diller,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The fifth regular meeting of the session of 1908–9 was held at the Chemists' Club on February 5.

The chairman, Dr. L. H. Baekeland, presented the results of an investigation which has occupied his attention for some years under the title, "Bakelite: its Synthesis, Constitution and Industrial Application."

Bakelite is a polymer of an oxybenzoyl-alcohol-methylene-glycol-anhydride having the formula $n(C_{43}H_{38}O_7)$. It is produced by the condensation of seven molecules of a phenolic body with one of formaldehyde. The pure substance is a hard, odorless, transparent mass resembling amber. It is insoluble in all solvents and extremely inert, resisting the action of strong chemicals and high temperatures. In its final form, Bakelite is not a plastic and would have few uses had it not been found possible to control the reaction by which it is formed and prepare intermediate condensation products. These may be incorporated with filling materials such as asbestos and wood pulp, molded into useful forms and finally hardened by the combined action of heat and pressure. The uses of Bakelite are being studied in more than forty different industries with excellent results; for example, in electricity it may be used for insulating devices and impregnating the coils of dynamos; in mechanics for bearings; in chemistry for lining wooden and metal tanks and protecting apparatus; in manufactures for making pool balls, pipe bits and buttons.

Dr. Baekeland's paper will appear later in full in the *Journal of Industrial and Engineering Chemistry*.

The other papers presented were:

M. A. Rosanoff, A. B. Lamb and F. E. Breithut: "A New Method of Determining the Partial Vapor Pressure of Binary Mixtures."

D. D. Jackson and W. A. Horton: "Experiments on the Putrescibility Test for Sewage and Sewage Effluents."

S. A. Tucker, W. A. Alexander and H. K. Hudson: "The Relative Efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide."

C. M. Joyce,
Secretary